Confessions of a Lapsed Neo-Davidsonian

Events and Arguments in Compositional Semantics

Samuel Louis Bayer

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Preface

A doctoral dissertation is an odd beast. It is, for many people, the largest single project ever to be undertaken, but it is produced at the very beginning of one's scholarly career. It is implicitly formulated as an answer, but by its very size and scope it raises more questions than it can ever hope to address, and documents the authoritative opinion of an academic babe in the woods. So it is more likely, it seems to me, that dissertations will be demonstrably flawed than other, subsequent work, and so it is with the dissertation you hold in your hand.

In this dissertation, I addressed the properties of thematic roles in the context of an event semantics. I was specifically interested in whether it was possible to show that thematic roles were indispensable objects in compositional semantics, and what a syntax/semantics map which incorporated such objects might look like. In the course of this investigation, I reached three major conclusions. First, I concluded that the evidence presented in the literature so far clearly favors a semantics which incorporates events (as opposed to one which has no such extended valence for predicates), and that such a semantics is straightforwardly compatible with well-known generalizations about coordination and quantification. Second, I concluded that while previous versions of the syntax/semantics map which necessarily involved thematic roles were not adequate, it was possible to improve on existing models, although difficult problems remained. Third, and most important, I concluded that, while it might be possible to construct such a model, the available evidence could not justify the incorporation of thematic roles in semantic composition.

The first and second conclusions, I believe, are fundamentally right. The first, of course, was not particularly original; I followed many persuasive researchers (including Landman, Lasersohn, etc.) in reaching this conclusion. The second conclusion is more interesting: I believe the thematically-based grammar fragment I presented here is a noticeable improvement over previous proposals. The third conclusion, I am now convinced, is wrong. Two experiences lead me to this view.

When I completed my dissertation, I was asked for a copy by Barry Schein, whose book *Plurals and Events* addressed a very closely related set of issues. In fact, it was Schein who first presented what I considered to be the strongest possible argument in favor of thematic roles in semantic composition. I discuss this argument in detail in Chapter 7; it essentially relies on the group-forming properties of nonsubject distributive determiners. In that chapter, I concluded that the argument was simply too weak to go through, and admitted a number of plausible alternatives. After reading the crucial parts of the dissertation, Schein engaged me in a vigorous debate on this particular issue, and finally convinced me that none of the alternatives were plausible, and that suitable circumstances could be described which rendered crucial reference to thematic roles unavoidable.

The second experience was embodied in Bayer (1996b), which attempted to rework a small point from Chapter 8 as an LSA presentation. I had argued that while certain "passive-sensitive" modifiers appear at first blush to benefit from referring to thematic roles, upon closer examination thematic roles provided no advantage. However, I had failed to take into account potential interactions with the remainder of the grammar. In the course of examining this issue, I thought I had constructed an argument that Passive must be a word-level (as opposed to a phrase-level) operation, based on the interaction of agentless passives with quantificational indirect objects. Ironically, when I attempted to prepare this argument for my presentation, I realized that the conclusion that Passive was a word-level operation relied crucially on other assumptions made about the nature of quantification in the grammar, and when three different composition strategies were compared (ordered arguments without essential variables, ordered arguments with essential variables, and thematic roles), it turned out that the thematic role model required the fewest overall assumptions.

At this point, then, I am convinced of the plausibility, desirability, and (at least occasional) necessity of thematic roles in semantic composition. But the questions surrounding this proposal still intrigue me. By way of conclusion, I will discuss two outstanding issues.

First, it is still not clear what does and doesn't count as an essential argument in favor of thematic roles. In this dissertation, I rejected a large amount of purported evidence, and I still believe that most of my conclusions are justified. Although Schein has managed to persuade me that at least one of these arguments goes through, there are others in my dissertation about which he and I disagree. The most interesting has to do with the nature of certain "dream" sentences discussed by Parsons (Parsons, 1990) such as "I dreamed that I was kissed, but no one kissed me". Does the complete absence of a kisser challenge ordered argument accounts of event semantics, which entail the existence of a kisser for every kissing event? Is there truly no kisser in Parsons' example? I have found that the more I think about these cases, the more mysterious they become, and I believe that they will ultimately have something important to say about the nature of our conceptualization of events.

Second, if we must accept a thematic-role-based account of semantic composition, we have a lot of work to do to construct a monostratal syntax/semantics map. The problematic case I dwell on in this dissertation is the case of VP coordination; however, unbounded dependencies and V coordination present almost exactly the same difficulties. In essence, we rely extensively on lambda abstraction in monostratal accounts to postpone the saturation of inner argument positions until later points in the derivation; topicalization and other fronting operations are good examples of this. However, the thematic-role-based account which appears crucial does not exhibit argument positions *per se* on verbal projections; the interpretations of V, VP and S are all sets of events. As a result, the crucial dependencies between thematic roles, participants, and the events these participants participate in threaten to be lost. For all I know, this tension may need to be resolved by some essential reference to variables; however, I have shied away from looking hard at this particular issue.

So there you have it. In the final analysis, what I considered the central conclusion of my dissertation stood up for all of three months, and I'm sure that some would argue that it only stood up for that long because I had managed to misunderstand Schein (1994) long enough to receive my diploma. Nevertheless, I have chosen to publish it as it was. For me, it still presents a coherent image of a difficult problem, and while one of the conclusions is wrong, the analysis of consequences is just as valid as it was when it was written, and I offer it as a guide and reference point for those who wish to pursue similar questions.

Samuel Bayer
February 1997

Acknowledgments

Does the world need another semanticist? No one asked that question before signing this thesis, much to my relief. Newly credentialed, I recognize all the more the wisdom of granting degrees on the basis of lofty intellectual principles, rather than the mundane considerations of employability. Last one out of the lattice of individuals, shut off the lights...

First, I'd like to thank my mother and my father, both of whom submitted comments on a previous draft[1]... just kidding. My father is a man of few words, and the ones he deems important I tend to remember. My mother is a woman of many words, and it is perhaps because of her that I began to love language. I am alive and free because of them in so many ways, and I thank them. But they just got the ball rolling.

A contemporary of Galileo's observed that one sometimes sees farther by standing on the shoulders of giants;[2] even those of us who don't see very far at all get to do that in graduate school. For my advisor, Pauline Jacobson, mere eternal gratitude is not enough. Even to a man whose life and career have been molded by exceptional women, Polly stands alone: an intellectual force of exceptional clarity, insight and rigor; a diligent, thoughtful mentor; a patient and dedicated teacher. I would not have come to Brown – in fact, I would not have gone to graduate school at all – if not for her. I have admired her since before I met her, years before I began my graduate education, and never truly wished to study with anyone else. She should be credited with whatever clarity of thought I can muster, whatever caution or discipline or rigor I can bring to my subject. It would not be too much to say that I am the scholar I am because of her, and no words can express my admiration and thanks.

Many others have also contributed to my intellectual development over the last four years. Mark Johnson has an unstoppably fertile and creative theoretical imagination, and has encouraged me to think about all sorts of issues, computational, logical and mathematical, and I am grateful. Peter Lasersohn has befriended me, shared his time, his quiet thoughtfulness, and his broad and scrupulous wisdom, and I am grateful. And to those who have taken their time in smaller ways, such as Manfred Krifka, Steve Sloman, Chris Barker, Barry Schein, Gennaro Chierchia, and David Dowty, who have challenged me to think about things in new ways, I am also grateful.

I owe a debt of sanity to my fellow students, without whom this experience would have been intolerable: to Emily, my friend and co-conspirator; to Eun-Joo, my intellectual colleague who shared the burden of persuading Polly there are events; to Amit and Paul, for their friendship, help and perspective; to Gary Strangman, always one insult behind; to Gary Byma, Steve Finney, Jennifer, Jean, Rushen, and everyone else in the luncheon gang, for making the department a place of fun and warmth for their classmates.

I could go on. I could thank lovers; I could thank coworkers; I could thank teachers; I could thank relatives; I could thank friends. I could thank the musicians I've performed with and the foosball players I've been delinquent with and the pool players I've been even more delinquent with. I could thank Maureen, who put up with the numberless days I deprived myself of her company while my faithful Powerbook, Snoopy, and I stitched this monstrosity together. I could thank Mitch and Jack and Irene and Judi and Jim and Ron and Sara and Amanda and Candace and Lynette and Ellen (both of them) and Toots and David and Josh and Stan and Larry Horn and Jackie Tappenden and I do not have room to thank them all. In fact, I barely have room to thank the people directly involved with my graduate education. My life is a warm, glorious pond of people, wonderful people who have turned to me and opened their minds, their hearts, given their time and wisdom and affection, and I can only hope to have returned it in some way. To all of you, I give my thanks, and I say: that's *Doctor* Bayer to you.

Notes

[1]Maureen Gustafson (p.c.).

[2]The exact quote is from Robert Burton (1576-1640): "I say with Didacus Stella, a dwarf standing on the shoulders of a giant may see further than a giant himself."

List of abbreviations

AP	adjectival phrase
CG	Categorial Grammar
CN	common noun
DO	direct object
DRT	Discourse Representation Theory
FA	Function Application
FC	Function Composition
GB	Government-Binding
GPSG	Generalized Phrase Structure Grammar
GQ	generalized quantifier
GR	grammatical relation
IP	Infl phrase
IV	intransitive verb
LF	logical form
LSA	Linguistic Society of America
NCC	non-constituent coordination
NP	noun phrase
PTQ	Montague (1973)
QR	Quantifier Raising
RNR	Right Node Raising
S	sentence
SU	subject
TR	Type Raising
TV	transitive verb
TVP	transitive verb phrase
VP	verb phrase

Chapter 1

Introduction

How are participants associated with the eventualities they participate in? Are there events? Thematic roles? The pioneering work of Montague (1970a; 1970b; 1973) was ontologically quite conservative on these issues; although Montague embraced worlds and times as elements of his models, his universe of individuals did not encompass worlds, times, or events. However, in recent years, theorists as diverse as Partee (Partee, 1984) and Parsons (Parsons, 1990), Lasersohn (1988; 1990; 1992; 1995) and Higginbotham (Higginbotham, 1983), Schein (Schein, 1994) and Krifka (1989; 1990b; 1992), have fruitfully explored the consequences of embracing events as referrable, manipulable entities in linguistic semantics. In this study, I will address the implications of embracing such elements for compositional accounts of semantics.

1.1 Flavors of event semantics

Event-based accounts of semantics have come in two basic flavors: Davidsonian and neo-Davidsonian.[1] These terms honor the pioneering work of Donald Davidson (Davidson, 1967) in introducing events into semantic representations. A pure Davidsonian account is one which extends the valence of predicates by one position, occupied by an event individual:

(1.1a) Classical: $[\![\text{run}]\!] = \lambda x[run'(x)]$[2]
(1.1b) Davidsonian: $[\![\text{run}]\!] = \lambda x \lambda e[run'(x)(e)]$

This event argument appears in the neo-Davidsonian account as well, and in both accounts the question that immediately arises is how this argument is saturated, since it does not correspond to any surface complement of the verb. Typically, in these accounts, this argument is bound by an existential quantifier at some point in the derivation. This operation of *existential closure* is commonly taken to happen at the end of the derivation, resulting in an expression such as the following:[3]

(1.2) $[\![\text{John runs}]\!] = \exists e(run'(j)(e))$

Also, in these accounts, modification of verbal projections frequently involves predicating something of event elements, in the same way that noun modification frequently involves predicating something of individuals:

(1.3) $[\![\text{run at noon}]\!] = \lambda x \lambda e[run'(x)(e) \wedge at'(noon')(e)]$

(1.4) $[\![\text{city in Texas}]\!] = \lambda x[city'(x) \wedge in'(texas')(x)]$

We will see below, in Chapter 2, that this parallelism of modification is one of the most elegant arguments for events in sentence semantics.

The fundamental difference between Davidsonian and neo-Davidsonian accounts lies in the way that each account associates participants with the events they participate in. I will refer to this issue with the term *argument indexing*. Davidsonian argument indexing relies on order and valence reduction, just as the classical account does; however, neo-Davidsonian accounts adopt a radically different strategy. Verbal predicates denote sets of events, and explicit relations, commonly called *thematic roles*, relate events to their participants. For the moment, I will make no ontological commitments about the nature of thematic roles. I will notate them as $\theta_{GR,P}$, where GR is some (deep) grammatical relation and P is an event predicate such as run'. In employing such a notation, I intend to remain agnostic about whether these roles correspond to broad thematic roles like $Agent$ or $Theme$ or to narrow thematic roles like $runner'$. An account employing this notation might result in a denotation such as

(1.5) $[\![\text{John runs}]\!] = \exists e(run'(e) \wedge \theta_{SU,run'}(j)(e))$

Thus, in some formal sense, the distinction between event modifiers and arguments has been eliminated; all dependents are introduced as conjuncts.

Formally, there are two ways to use thematic roles for argument indexing. The first strategy, which I will call the *lexical* strategy, encapsulates the connection in the meaning of the verb, as follows:

(1.6) $[\![\text{chase}]\!] =$
$\lambda y \lambda x \lambda e[chase'(e) \wedge \theta_{SU,chase'}(x)(e) \wedge \theta_{DO,chase'}(y)(e)]$

This first strategy is represented by Landman (1993). The second strategy, which I will call the *compositional* strategy, takes the meanings of verbs to be sets of events:

(1.7) $[\![\text{chase}]\!] = \lambda e[chase'(e)]$

In such an account, thematic roles are required to link the denotations of verbal arguments with the events which correspond to the denotations of verbs. I will call this strategy *thematic indexing*. Since the verbal denotation itself hardly ever provides the thematic roles in the second strategy,[4] the roles must come from some other source. Typically, some other property of the event-denoting constituent provides them, either through some sort of feature matching (Krifka, 1992) or some other source of information associated with the verb which is not made explicit (Parsons, 1990; Schein, 1994). This general strategy has been the basis of what few attempts there have been (Krifka, 1989; Krifka, 1992) to develop an explicit syntax/semantics interface for the compositional strategy for neo-Davidsonian semantics.

1.2 Evaluating event semantics

As the ontological world of model-theoretic semantics expanded, work in classical, eventless semantics fruitfully continued. Consequently, the results in the two domains have frequently diverged. Some researchers have begun to reintegrate the two threads (Lasersohn (1995) is a notable example), and this reintegration is crucial to making unified progress in the field of semantics. In particular, the mismatch between semantic and syntactic argument structure implied by event-based accounts of semantics requires us to reexamine the properties of the syntax/semantics interface.

What issues, then, are crucial for the event semanticist to address? It seems to me that two of the most influential results in semantics have been the theory of generalized quantifiers (Barwise and Cooper (1981), Montague (1973)) and the account of generalized conjunction (Gazdar (1980), Keenan and Faltz (1985), Partee and Rooth (1983), etc.). These results have had wide impact on the course of work in semantics and important implications for the syntax/semantics interface. It seems, then, that event-based accounts of semantics must insightfully address at least these two issues.

So how responsive are Davidsonian and neo-Davidsonian accounts to compositional considerations at the syntax/semantics interface? From this point of view, the lexical neo-Davidsonian strategy is essentially equivalent to the Davidsonian strategy, since the properties of these two accounts (ordered arguments corresponding to participants, an additional event argument) are identical for the purposes of combinatorics. And these accounts have had a reasonable degree of success addressing classical concerns of generalized quantification and generalized conjunction (see Lasersohn (1995), Landman (1993)).

The compositional neo-Davidsonian strategy, on the other hand, assumes a more onerous burden of proof. Thematic roles are central to such an account, because they are the objects which link participants with the events they participate in. So in addition to addressing the classical concerns enumerated above, this latter strategy must demonstrate the model-theoretic *plausibility* of thematic roles, and show the compositional *advantage* of indexing arguments in this non-traditional way.

All three of these issues have been discussed, at least to some extent. The responsibility of such an account to classical concerns has occasionally been addressed; Krifka (1989; 1992), who faces such issues most explicitly, deals with the properties of quantifiers to some degree, but he does not address the properties of coordination. Furthermore, the nature of the syntax/semantics interface in Krifka's account is somewhat imprecise. The model-theoretic and ontological plausibility of thematic roles, on the other hand, has been widely debated, with Jackendoff (1983; 1990) as a recent defender and David Dowty as a recent explicator (Dowty, 1989) and critic (Dowty, 1991).

The final issue, however, is arguably the most crucial. Addressing classical concerns, for example, is of only passing interest unless there is some demonstrable *advantage* to the neo-Davidsonian argument indexing strategy. It will turn out that while (perhaps surprisingly) there is no convincing obstacle to addressing issues of coordination and quantification in this account, there is no evidence that we need the account at all. In this study, I will argue that in all cases, the supposed advantage to be derived from the neo-Davidsonian indexing strategy is illusory, and in most circumstances either helps not at all or makes the wrong predictions. In the one case where it appears that a neo-Davidsonian strategy has some real benefit, I will demonstrate that the relevant behavior must be attributed to independently determined properties of events.

The study is organized as follows. In Chapter 2, I provide an initial motivation for event semantics. In Chapter 3, I lay out the classical concerns of plurality, distributivity and quantification which inform the analysis to come. In Chapter 4, I present a Davidsonian account of the syntax/semantics interface couched in Categorial Grammar. In Chapter 5, I digress briefly to elaborate on two aspects of this account – existential closure and the size of events – which have been insufficiently addressed in the literature. In Chapter 6, I'll introduce the notion of thematic indexing and exemplify the compositional neo-Davidsonian strategy in detail. In Chapter 7, I'll compare the compositional neo-Davidsonian strategy to the more conservative Davidsonian approach; I'll examine a wide range of previous arguments in favor of neo-Davidsonian semantics and demonstrate that in each case, they are either arguments for thematic roles as entities but not for thematic indexing as a composition strategy, or that they do not demonstrate any advantage for the thematic indexing strategy in composition. Finally, in Chapter 8, I will introduce the problem of the Passive *by*-phrase, illustrating how a neo-Davidsonian indexing strategy provides an initially plausible account. However, the value of this account will prove to be illusory. I will show how both the Passive *by*-phrase and the facts of verbal modification support the generalization that events must make accessible the canonical order of their arguments, and I will show how this accessibility can be made possible.

Notes

[1]This latter term seems to be due to Dowty (1989).

[2]I will ignore intensionality for the moment.

[3]I will return to the properties of existential closure in Chapter 5 below.

[4]The one exception I am aware of is a family of accounts exemplified by Krifka (1989), in which thematic roles are embodied in the verbal denotation, as in the lexical neo-Davidsonian strategy, but the elements which bear these roles are free, rather than bound, variables, and the mapping between these arguments positions and syntactic argument position is accomplished via some sort of matching operation (unification, perhaps):

(i) $[\![\text{chase}]\!] =$
$\lambda e[chase'(e) \wedge \theta_{SU,chase'}(x_{SU})(e) \wedge \theta_{DO,chase'}(y_{DO})(e)]$

This account is discussed in Appendix A. While Krifka (p. c.) suggests that this account might be viewed as Davidsonian, for me it is clearly an instance of the compositional neo-Davidsonian strategy, since all verbal projections bear the same semantic type. See Chapter 6 for an extended discussion of the properties of compositional neo-Davidsonian approaches.

Chapter 2

Events: An Initial Justification

While the particular manner of incorporating events into semantics is still a matter of some debate, I think the arguments in favor of doing so in some way are quite convincing. In this chapter, I will provide initial justifications for event-based semantics. I will present two arguments which rely entirely on familiar assumptions, to set the stage for subsequent discussion.

2.1 The Davidsonian element

The most obvious indication that things that happen are not defined exclusively in terms of their participants is the behavior of adverbs like *twice*:

(2.1) LaToya saw Michael twice.

In an extensional, set-theoretic view of semantics, we cannot represent this state of affairs by having two occurrences of the tuple $\langle l, m\rangle$ in the denotation of *see*, because by definition, such a denotation is equivalent to one in which that tuple occurs only once. So we must exploit other tools.

Fortunately, the Montagovian "toolbox" provides a number of entities and concepts we might use to make the distinctions we need. First of all, we can try to exploit intensionality. The meaning (as opposed to the denotation) of *see* is a function from world-time pairs to a set of pairs of individuals. So maybe we can validate (2.1) by finding more than one time which maps to a denotation of *see* which contains the pair $\langle l, m\rangle$.

Given that it seems that we might actually need to refer to and manipulate times, a more attractive option might be to extend the Montagovian account to admit times as individuals. Frequency adverbs like *twice* in (2.1) might be taken to quantify over such times. So our denotation of *see* might look like (2.2):

(2.2) $see' = \{\ldots, \langle l, m, t_1 \rangle, \langle l, m, t_2 \rangle, \ldots\}$

If we found a need for finer granularity, we might introduce locations as well, and adopt an analysis in which participant sequences are augmented by pairs of times and locations, as in (2.3):

(2.3) $see' = \{\ldots, \langle l, m, \langle t_1, loc_1 \rangle\rangle, \langle l, m, \langle t_2, loc_2 \rangle\rangle, \ldots\}$

In both these cases, the sequence of participants typical of the classical account has been augmented by an additional parameter, which is intended to distinguish the intended eventuality from others with the same sequence of participants. I will call this additional parameter the *Davidsonian element.*

In this chapter, I will argue that this additional parameter is required in grammar. In addition, I will argue that this parameter cannot be filled by times, or times and places, since neither of these augmentations provides a fine enough degree of granularity to distinguish eventualities from one another. I will not, however, demonstrate conclusively what sort of element fills this position; I will amass little or no evidence which will distinguish events as unanalyzed individuals such as those found in, say, Krifka (1992) (which I will call *primitive events*) from the situations of Kratzer (1989), or even between Davidsonian elements as individuals and Davidsonian elements as structured objects as in Barwise and Etchemendy (1987). Making this choice is not relevant to the considerations of compositionality I will consider in this thesis.

2.2 Modification of events and parallelism

This first argument is one of the most commonly cited in favor of events in semantic representations. It originates in Davidson (1967) and is championed in Parsons (1990), but most thoroughly articulated in Landman (1993). The argument attempts to demonstrate parallels between nominal and verbal modification.

Modifiers fall into several broad classes. Some are intensional, like *fake*; a fake gun is not a gun. Others modifiers are scalar, with a contextually defined comparison class, like *long*; a long finger and a long highway are evaluated by considerably different standards. A third class, the ones we will be concerned with, are extensional and contextually independent, like *blue*.[1] These modifiers are called intersective modifiers, for reasons that will become clear in a moment.[2]

Intersective modifiers have two rather striking properties. Consider an example like (2.4):

(2.4) John is a forty-year-old, blond, blue-eyed American dressed in a suit, with a beard, in his midlife crisis.

First, these modifiers permit *permutation*. Syntax permitting, we can reorder the modifiers in any way and preserve truth, as in the comparison between (2.4) and (2.5):

(2.5) John is a blue-eyed, blond, forty-year-old American with a beard, dressed in a suit, in his midlife crisis.

Second, these modifiers license *drop*. Any utterance created by omitting modifiers from (2.4) is entailed by (2.4), as in (2.6):

(2.6) John is a blue-eyed American dressed in a suit.

Now, these properties are striking because all these nominal modifiers are commonly taken to have the same type, namely $\langle\langle e,t\rangle, \langle e,t\rangle\rangle$, functions from CN denotations to CN denotations. This semantic type, by itself, does not lead us to expect modifiers to exhibit the properties of permutation and drop, and in fact these properties don't always arise for nominal modifiers in general.[3] Scalar adjectives, for instance, can be dropped in the context of intersective adjectives with an intersective result, but not necessarily the other way around; so the set of big red fire engines is a subset of the set of red fire engines, but not necessarily a subset of the set of big fire engines, if *big* is taken to qualify *red fire engine* instead of *fire engine*. Furthermore, scalar adjectives can be permuted with each other, but not with intersective adjectives; but this fact is just one of many other generalizations about prenominal adjective order in English which does not clearly have anything to do with the semantics of the adjectives themselves.[4] Restrictions on intensional adjectives are considerably harsher; the set of fake French pastries is not a subset of the set of French pastries (in fact, it's disjoint from it), and the set of fake French pastries is not the same as the set of French fake pastries.

So what can we say about these intersective modifiers which will accurately capture their special properties? Let's focus on the permutation property for a moment. Landman points out that if we were to attempt to implement the permutation property directly, we would end up with a principle like this:

(2.7) Permutation closure:
For any CN and any set of (intersective) modifiers $A_1, \ldots, A_n$, let $\mathrm{PERM}(A_1(\ldots(A_n(CN))\ldots))$ be the set of all permutations of sequences of applications of the modifiers to CN. Then
$$\forall x \forall Z \in \mathrm{PERM}(A_1(\ldots(A_n(CN))\ldots))$$
$$(Z(x) \leftrightarrow A_1(\ldots(A_n(CN))\ldots)(x))$$

This principle can't be a meaning postulate about an individual modifier, because it addresses the permutation properties of an arbitrary number of modifiers. Landman objects to this principle on the grounds that it is a meaning postulate about a syntactic structure, and as such very unconventional and *ad hoc*.

I don't see why this needs to be interpreted as a syntactic principle, even in the sense of the syntax of logical form. The principle of permutation closure outlined here is a statement about a set of modifiers and the predicates that can be constructed out of them, and it proposes that all such predicates are model-theoretically equivalent. Each sequence of applications of these modifiers to the CN describes or names one of these predicates, but is not identical to it. It seems to me that this principle can be interpreted entirely in model-theoretic terms.

However, there is a good reason to reject this account. By itself, this principle describes the permutation properties of these modifiers; but an additional principle must be stated to account for the drop properties, as Landman points out. There is, however, an alternative hypothesis from which both permutation and drop follow, one which is expressed solely in terms of lexical items, rather than sets of predicates. This is the classical account. It identifies a modifier of type $\langle\langle e,t\rangle,\langle e,t\rangle\rangle$ as intersective if and only if it can be defined in terms of a corresponding predicate of type $\langle e,t\rangle$ as follows:

(2.8) $\alpha_{\langle\langle e,t\rangle,\langle e,t\rangle\rangle} = \lambda P \lambda x[P(x) \wedge \alpha'_{\langle e,t\rangle}(x)]$

Permutation and drop are entailed immediately by the properties of conjunction. What makes this analysis work, however, is not simply the fact that we're proposing an account in terms of conjunction; rather, it's also crucial that the modifiers denote, in their basic type, predicates over the same things the nouns denote. This is the property that permits them to *be* conjuncts.

With this account in hand, let's turn to verbal modification. As before, we will set aside intensional adverbs like *allegedly* and scalar adverbs like *quickly*. And if we focus on extensional, contextually independent adverbial elements, we again find that the facts of permutation and drop obtain. So (2.10) is equivalent to (2.9), and (2.11) is entailed by (2.9):

(2.9) Brutus stabbed Caesar in the back through his toga with a knife.[5]

(2.10) Brutus stabbed Caesar through his toga with a knife in the back.

(2.11) Brutus stabbed Caesar through his toga.

The only insightful explanation we found of these two properties above analyzed this type of modifiers as intersective. But because this analysis relies on the intersective property of conjunction, we must conclude that here as well, heads (verbs and verbal projections) and modifiers (adverbs) are predicates over the same elements. So what element is it that heads and modifiers are predicates over in the verbal case? The obvious candidate is the participant denoted by the subject; after all, we need a set of elements to participate in the intersection, and IVs denote sets of individuals. But where the sets of individuals denoted by CNs are perfect candidates for intersecting with modifiers, the denotations of IVs are not. So for instance, consider (2.12):

(2.12) Michael won the race by limping across the finish line.[6]

The verbal modifier *by limping across the finish line* cannot be predicated sensibly of either people or races. It cannot be taken as appositively describing Michael as he won the race, because (2.12) says more: it is by virtue of limping across the finish line that Michael won the race. Taking the modifier as ranging over races is even more egregiously nonsensical. Landman argues that there must be another, implicit argument which is the "hook" for the intersective account of verbal modifiers. Thus, Landman's argument supports my first contention: that verbal denotations include a Davidsonian argument position.

What can we say about the object which fills this position? We can easily show that it cannot be a time or a time-location pair. Consider the minimal spatiotemporal location associated with Michael's winning the race in (2.12):

(2.13) $[\![\text{Michael win the race}]\!] = \langle \ldots, \langle t_1, loc_1 \rangle, \ldots \rangle$

Assume, further, that Michael's winning the race is spatiotemporally collocated with Michael's collapsing from fatigue:

(2.14) $[\![\text{Michael collapse from fatigue}]\!] = \langle \ldots, \langle t_1, loc_1 \rangle, \ldots \rangle$

Now, recall that in this minimal spatiotemporal location which is Michael's winning the race, Michael wins the race by limping over the finish line, as in (2.12). Since *by limping across the finish line* is an intersective modifier, this spatiotemporal location here must be in the denotation of the modifier as well, and we ought to be able to conclude (2.15):

(2.15) Michael collapsed from fatigue by limping across the finish line.

This inference is, to be charitable, invalid; in fact, (2.15) is incoherent. It seems that times and locations do not provide enough fine-grained structure to support our linguistic intuitions. So at the very least, we know that these elements cannot serve as our Davidsonian elements.

2.3 Frequency adverbials

Additional evidence against times or locations as Davidsonian elements arises in elaborating my initial discussion of the counting properties of adverbs like *twice*. This argument was developed by Landman (1993). The proof lies in the following potential answer to the question "How many times did Brutus stab Caesar?":

(2.16) I saw him do it. It was revolting. In each hand, he had a hayfork. He stabbed him with the one in the front, and with the other in the back at the same time.[7] So he stabbed him twice.

If Brutus stabbed Caesar twice, there must be two of *something* in this example. Is it times? Adverbs like *twice* can count times, as (2.1) seems to suggest; but since the wounds are inflicted simultaneously here, it can't be times that we're counting. Is it locations? Landman argues that it cannot be locations either, because each hayfork inflicts several wounds, one for each tine, in different locations, and so there are more than two locations involved. Landman concludes that we must be counting something else.

The name that Landman gives this "something else" is *events*. However, his subsequent discussion makes clear that he does not necessarily intend these elements to be primitive events; he seems to leave open the possibility that his events are structured objects. What he intends is that there is some plausible level of representation of what happens or holds which is divisible into discrete units according to some plausible metric, and these units are more fine-grained than times or locations. Let us follow Landman for the moment, then, and interpret events as plausibly discrete Davidsonian elements of sufficient granularity.

So Landman is arguing that the number of times, locations and events are all different, and the number of events is the "right" number.[8] However, I don't think locations can be dismissed so neatly. In discussing this case, Landman ignores the granularity of locations. If we deal with locations on a coarser level than the tines of the hayfork, we can plausibly say that there *are* two locations involved: the front and the back. So it is at least initially plausible to conclude that locations are being counted in (2.16). Because the possibility remains that the number of locations and the number of events is the same, we cannot yet determine which one is being counted by the frequency adverbial.[9]

Now, times can have the same ambiguities of granularity that locations do. But Landman eliminates this possibility in (2.16) by setting up a situation involving a single time. So in order to resolve this open question about events vs. locations, all we need to do is guarantee that there's only one location. That is, if we set up a situation where there is one time, one location, and many events, any frequency adverbial other than *once* must be counting events. So consider a physics experiment where a light-sensitive element is targeted by multiple laser beams in order to measure the effectiveness of using laser beams for transferring energy. The beams are all focused on the same location and fired simultaneously in instantaneous bursts. In the first trial, one laser is fired; in the second, two of them are. A student compares the results and has the following exchange with his professor:

(2.17a) Student: Why are the energy levels higher in the second trial?

(2.17b) Professor: Because the target was struck twice.

One location; one time; two events. One might argue that because the lasers are positioned in different places, the locations involved are not the same. However, it's easy to show that as far as linguistic semantics is concerned, the location of a striking event is the location of the object struck, and the location of the striker is irrelevant. For instance, say the target moves from position to position, and multiple laser beams are trained on each position. During the first trial, the target stops at all of its designated positions, and at every position but one, it is struck by only one laser beam. I now utter either (2.18a) or (2.18b). I cite both active and passive examples to demonstrate that the orientation of the locative PP is independent of voice:[10]

(2.18a) The target was struck twice at one position.
(2.18b) The lasers struck the target twice at one position.

The adverbial modifier *at one position* is appropriate in spite of the fact that the two laser beams which struck the target are located in different places. Given this evidence, it would be quite a stretch to maintain that the location of the striker was relevant for the determination of event location for frequency adverbials, but not for locative adverbials. Therefore I conclude, with Landman, that neither times nor locations can account for the semantics of frequency adverbials.

Now, while this argument provides further evidence for the nature of the Davidsonian element, it does not demonstrate a need for a Davidsonian argument position directly. However, the hypothesis of a Davidsonian argument position seems to be the simplest one consistent with the facts: sentences denote sets of Davidsonian elements, and *twice* is a cardinality predicate on such a set.

2.4 Quantification over events

My final argument for Davidsonian semantics has to do with adverbial quantification and reference to Davidsonian elements. Consider the following example:

(2.19) Whenever/Every time the bell rings, it wakes Mary up.

This example provides two potential sources of evidence. First, we have a (possibly implicit) adverbial modifier which quantifies over some sort of entity, and the fact that *every time* looks like a frequency adverbial (cf. *three times*) raises the obvious possibility that the subordinating element is quantifying over the same sort of element we saw a moment ago. Second, the pronoun *it* appears to be a bound pronoun which refers to whatever is being quantified over in the adverbial clause. I will take up each of these issues in turn.

2.4.1 Adverbial quantification

I will begin with the recent work of Rothstein (1995). Rothstein argues that examples involving *every time* involve quantification over Davidsonian elements (which, like Landman, she calls *events*) in a manner parallel to quantification over individuals, and furthermore involves a "matching effect" which requires that for every event in the denotation of the complement of *every time*, there is a corresponding event in the denotation of the main clause. So in (2.20), there is a different door opening for each bell ringing:

(2.20) Every time the bell rings, Mary opens the door.

Her analysis of (2.20) is roughly[11]

(2.21) $\forall e(ring'(the\text{−}bell')(e) \rightarrow$
$\exists e'(open'(the\text{−}door')(m)(e') \wedge M(e') = e))$

Without the function M mapping main-clause events onto subordinate-clause events, (2.20) would be true as long as there was at least one event of Mary opening the door, which is wrong. This contrasts with nominal quantification, where the matching effect does not hold:

(2.22) Every girl in the class saw a movie last night. Some of them saw "Beauty and the Beast", and the rest saw "The Terminator".

Although Rothstein does not provide firm guidelines for the conditions under which the mapping in M is determined (she demonstrates, in fact, that it is not always time and it is not always causation), she argues convincingly that the matching effect is real.

Rothstein presents arguments that the use of the word *time* here is not temporal. For instance, she points out that adjectives like *short*, which can modify the temporal use, cannot appear in the construction under consideration here:

(2.23) *Every short time the bell rings, Mary opens the door.

Thus, Rothstein concludes that the Davidsonian argument position she assumes is not filled by times. However, she does not show what it *is* filled by, and in fact she attempts another distinction which I believe is incorrect.

Rothstein differentiates *every time* quantification from quantification over cases involving *when/if/whenever* (cf. Lewis (1975)) on the basis of the following contrast:

(2.24a) When/if a quadratic equation of this sort has a solution, it is always positive.
(2.24b) Whenever a quadratic equation of this sort has a solution, it is positive.
(2.24c) ?Every time a quadratic equation of this sort has a solution, it is positive.

Rothstein concludes that *every time* quantification and quantification over cases must be different, although she does not identify what the difference is.

If Rothstein is right, whatever we conclude about *every time* might not inform our conclusions about other adverbial quantificational elements. There are indeed some very important contrasts between *every time* and *when/if*, since the former seems to be a genuine adverbial quantifier and the latter, according to de Swart (1991), are not quantifiers themselves but rather subordinating elements which identify the restrictor of a possibly implicit generalized quantifier. We can illustrate this contrast by showing that while *when* and *if* are compatible with an explicit adverbial quantifier, *every time* is not:

(2.25a) When/if the bell rings, Mary always/usually/seldom/never opens the door.
(2.25b) Every time the bell rings, Mary ?always/*usually/*seldom/*never opens the door.[12]

But in the overall semantics which concerns us here, whether the quantificational force originates in an implicit or explicit adverbial quantifier or in the subordinating element itself is a fairly minor detail. With respect to almost every other diagnostic, *every time*, *when*, *whenever* and *if* pattern identically. For instance, in discussing the contrast noted above, Rothstein points out that the contrast is not one of stativity, because examples involving stage-level statives are unexceptional (cf. (2.26a)). However, she also notes that individual-level statives are much worse (cf. (2.26b)), unless they can be construed as stage-level (cf. (2.26c)):

(2.26a) Every time Mary is available, somebody asks her a question.
(2.26b) *Every time Mary is intelligent, somebody asks her a question.
(2.26c) ?Every time Mary is blonde, somebody compliments her.

But what Rothstein fails to observe is that this pattern of contrasts holds for *whenever* and *when* as well:

(2.27a) When/whenever Mary is available, somebody asks her a question.
(2.27b) *When/whenever Mary is intelligent, somebody asks her a question.
(2.27c) ?When/whenever Mary is blonde, somebody compliments her.

In other words, whatever contrasts are induced for *every time* by the individual/stage distinction are induced for *when* and *whenever* as well. Furthermore, it seems that *whenever* seems to induce the same matching effect that *every time* does, as shown in (2.28):

(2.28) Whenever the bell rings, Mary opens the door.

If there are multiple bell ringings, a single door opening cannot render (2.28) true any more or less than it renders (2.20) true.

The most elaborate parallel can be drawn in examining the so-called *proportion problem* found in adverbial quantification (as discussed in Kadmon (1987), Kadmon (1990), Heim (1990), Chierchia (1992), and references therein). If these quantifiers quantify over either cases or events, we expect that proportion judgments with adverbs like *usually* will weight each event or case equally. This expectation is borne out in (2.29):

(2.29) If a woman marries a man, she usually loves him.

This example seems to count husband-wife pairs; so if one woman's or man's bad marriages account for the majority of marriages, (2.29) is falsified. However, our expectation is *not* borne out in an example like (2.30):

(2.30) If a painter lives in a village, it is usually pretty.

It seems that this example counts villages, not village-painter pairs; so if a single ugly village houses the majority of painters, (2.30) is not falsified.

Initially, these two examples might lead one to conclude that the parameters of quantification are determined by how many pronouns there are in the main clause and what they refer to, but Chierchia (1992) argues that this generalization is incorrect. His examples are particularly pernicious, because the events or cases which "count" toward the proportion judgment vary with the discourse topic established by previous context. Consider the contrast between (2.31a) and (2.31b):

(2.31a) Dolphins are truly remarkable. When a trainer trains a dolphin, she usually makes it do incredible things.
(2.31b) Trainers from here are absolutely remarkable with all sorts of animals. For example, when a trainer from here trains a dolphin, she usually makes it do incredible things.

Chierchia argues that (2.31a) is intuitively true if most dolphins do incredible things when appropriately trained. If one dolphin is exceptionally stupid, and is trained over and over and never learns a thing, (2.31a) is not falsified, even if as a result the number of successful dolphin-training situations no longer constitutes most of the events in which a trainer trains a dolphin. That is, (2.31a) is about dolphins, and seems to quantify over them. Conversely, (2.31b) remains intuitively true even if there is one incompetent trainer who trains dozens of dolphins and never teaches them a thing, and these failed dolphin-training situations constitute the majority of dolphin-training situations under consideration. That is, (2.31b) is about trainers, and seems to quantify over them. So the relevant consideration for establishing the parameters of quantification involve discourse considerations rather than explicit pronominal binding.

The implications of the proportion problem are severe for either quantification over events or quantification over cases. In the dolphin case, we would be quantifying over either training events or trainer-dolphin pairs, and under either hypothesis not all the elements in the set being quantified over count equally (or count at all!) toward the determination of the proportionality judgment. The parallel with Rothstein's cases emerges when we substitute *most of the times* for *when/if*:

(2.32a) Dolphins are truly remarkable. Most of the times a trainer trains a dolphin, she makes it do incredible things.
(2.32b) Trainers from here are absolutely remarkable with all sorts of animals. For example, most of the times a trainer from here trains a dolphin, she makes it do incredible things.

I believe that Chierchia's arguments about discourse topics and proportionality apply equally well to (2.32a) and (2.32b).[13] I conclude, then, that there is no relevant difference between the quantificational properties of *every time*, *when* or *whenever*.[14]

2.4.2 *Eventuality reference*

Having established the parallel nature of these subordinating elements with respect to the individual/stage contrast, the matching effect and the proportion problem, I can now turn to reference to Davidsonian elements in these quantificational constructions. I will begin by reviewing some of the properties of reference to Davidsonian elements by Ss and by NPs. In the discussion to follow, I will refer to such reference as eventuality reference, in order to emphasize the fact that the status of the Davidsonian element being referred to is at issue.

The range of elements which Ss seem to be able to refer to comprises at least Davidsonian elements and propositions;[15] however, Ss seem to differ in their range of referential possibilities as arguments and as anaphors. For instance, Vendler (1967) points out that NPs but not Ss can introduce Davidsonian elements as arguments, while either can introduce propositions. Vendler's justification for this conclusion rests on the observation that "containers" like *surprise* are consistent with elements which are propositional, while *happen* or *occur* are not and seem to require actual Davidsonian elements:

(2.33a) The non-arrival of the train surprised me.
(2.33b) *The non-arrival of the train occurred at noon.

Ss can occur in propositional containers, but not in event containers, suggesting that S arguments can only denote propositions, not Davidsonian elements:

(2.34a) The arrival of the train surprised me.
(2.34b) The arrival of the train occurred at noon.
(2.34c) That the train arrived surprised me.
(2.34d) *That the train arrived occurred at noon.

On the other hand, matrix unnegated Ss can introduce elements into the discourse which can be referred to by subsequent pronouns in either container. Negated Ss, which cannot correspond to actual Davidsonian elements, do not support reference in event containers. These facts are discussed by Bäuerle (1988):

(2.35a) The train broke down. It surprised me.
(2.35b) The train didn't break down. It surprised me.
(2.35c) The train broke down. It happened at the station.
(2.35d) *The train didn't break down. It happened at the station.

So Ss which potentially describe Davidsonian elements as well as propositions may introduce Davidsonian elements into the discourse history, but may not denote Davidsonian elements in argument positions.

With these observations in hand, we turn to eventuality reference in adverbial quantification. Consider the cases in (2.36):

(2.36a) Whenever/every time the train broke down, it surprised the conductor.
(2.36b) Whenever/every time the train didn't break down, it surprised the conductor.
(2.36c) Whenever/every time the train broke down, it happened a hundred yards from the station.
(2.36d) *Whenever/every time the train didn't break down, it happened a hundred yards from the station.

Here we see that the anaphoric possibilities in these quantificational contexts are identical to those in discourse anaphora. The cases we are interested in are those where the main clause features an Davidsonian element container like *happen*, as in (2.36c). The question we must address is what type of Davidsonian element the pronoun refers to.

As a backdrop to this question, I will first establish that reference to Davidsonian elements does not change the basic properties of adverbial quantification. For example, examples involving eventuality reference induce the matching effect, as demonstrated here with the Davidsonian element container *saw*:

(2.37) Every time the train broke down, the conductor saw it.

If there are many breakdowns, there must be a Davidsonian element of seeing for each one. Second, examples involving eventuality reference exhibit the proportion problem, further confirming Chierchia's claim that what determines the asymmetry in such examples is discourse rather than pronominal dependencies:

(2.38a) Dolphins are truly remarkable. When a trainer trains a dolphin, it usually takes less than an hour.
(2.38b) Trainers from here are absolutely remarkable with all sorts of animals. For example, when a trainer from here trains a dolphin, it usually takes less than an hour.

Just as with Chierchia's original examples, it seems that dolphins determine the proportionality in (2.38a), and trainers determine the proportionality in (2.38b).[16]

In considering what sort of object the pronoun refers to in examples like (2.36c), I ought to consider proportional examples, in order to verify that the proportion problem does not interfere with our conclusions. Furthermore, we need not make the assumption that the element which the pronoun in the main clause refers to is of the same type as the elements in the set being quantified over. So consider (2.39):

(2.39) When a train breaks down, it usually happens without anyone watching.

What sort of entities do the pronoun *it* and the embedded S refer to? Are times, or pairs of times and locations, enough to account for (2.39)? I think the answer is obviously not. Assume for convenience that the subordinate clause denotes a set of Davidsonian elements, whatever they may be. Assume on the other hand that the element which *it* refers to is specifically a spatiotemporal location. Then what we're asserting in (2.39), for instance, is that for most Davidsonian elements which constitute a train breakdown, the spatiotemporal location of each element of the proportionality set determined by *usually* happens without anyone watching. But even if we assume that the spatiotemporal location in question is as small as it can be, it seems clear that we have underdescribed what is going on. It's not the case that *everything* at that spatiotemporal location happens without anyone watching. For instance, if it's raining while a train is breaking down, I certainly should not be able to conclude from (2.39) that most of the time nobody is watching the rain in the same location. Yet if all we're referring to is spatiotemporal locations, I must either conclude that *everything* at that spatiotemporal location happens without anyone watching, which is clearly wrong, or that *something* at that spatiotemporal location happens without anyone watching, in which case I can't even infer from (2.39) that it is specifically the train breakdowns that usually aren't being watched, since I've made a statement about spatiotemporal locations, not events. To me, it seems impossible to avoid the conclusion that times and locations are simply not fine-grained enough to support the proper analysis of pronominal reference in (2.36c).

2.5 The type of the Davidsonian element

If we rule out times and spatiotemporal locations as Davidsonian elements, we have by no means exhausted the commonly available candidates. Among our options are:

- worlds and propositions;
- situations (Kratzer (1989), Portner (1992))
- other, unanalyzed primitive individuals (Krifka (1989; 1990b; 1992), Lasersohn (1995))
- properties of moments of time (Montague (1969))
- "aspects" of situations (Landman (1993)), perhaps implemented pairs of situations and proposition types (Barwise and Etchemendy (1987))

In this section, I will discuss the plausibility of some of these alternatives.

2.5.1 Situations, worlds and propositions

We might arrive at the notion of situations as follows. The original Montagovian program introduced worlds and times as primitives in the model, although there was no facility provided for referring to either type of element. One way of understanding this distinction is that while models had sets of worlds and times as components, the original Montagovian program did not make these sets subsets of the domain of individuals. So if we were to examine the model for elements which might serve as Davidsonian elements, we have two candidates which could be introduced into the domain of individuals which could be considered for this role. We saw that of these candidates, times are not appropriate as Davidsonian elements; furthermore, it ought to be clear that worlds are way too "large" to serve as Davidsonian elements, since they fail to distinguish in any given world between any two events with the same participant sequence. So in world w, we cannot use world w itself as the Davidsonian element, because if LaToya loves Michael and LaToya kisses Michael, the two eventualities will be indistinguishable:

(2.40a) $[\![\text{love}]\!] = \{\ldots, \langle w, l, m\rangle, \ldots\}$
(2.40b) $[\![\text{kiss}]\!] = \{\ldots, \langle w, l, m\rangle, \ldots\}$

The obvious objection to this simplistic attempt to make do with the tools we already have (an attempt which, by the way, no one to my knowledge has been foolish enough to make) is that it fails to exploit the nature of worlds as alternative ways things could be. Presumably, we could easily distinguish between loving and kissing eventualities by using *sets* of worlds as the Davidsonian element.[17] Since the worlds in which LaToya loves Michael are not necessarily the same worlds in which LaToya kisses Michael, we can easily distinguish between the two eventualities in question. By making this refinement, we have essentially introduced situations as Davidsonian elements.

The basic idea of situations as information states goes back at least to Kripke (1965), and has been subsequently expanded by Veltman (1981), Barwise and Perry (1983), Landman (1986), Kratzer (1989) and others. Kripke's interpretation begins with the view that propositions are basic, and worlds are functions from propositions to truth values. But they're a special type of function; they're total. Situations, on the other hand, are *partial* functions from propositions to truth values. These functions can be ordered by the size of their domains, and any situation (partial function) can "grow" into a (potentially infinite) set of worlds (total functions). This growth is governed by the axiom of *persistence*. The set of situations in which a given proposition p is true must be persistent in that if some situation s is in this set, every situation $s' > s$ must also be in this set. Since worlds are sets of propositions which correspond to total functions, the intersection of a set of worlds defines a potentially smaller set of propositions, thus a situation. So we can represent situations by the set of worlds they grow into, which is why I identified situations with sets of worlds in the previous paragraph.

Now, primitive propositions are not the sort of thing which can be used as our Davidsonian elements. They are not located in space; nor do they have means or manners; nor are they watched; nor do they extend in time. All these things would have to be true if propositions were used as Davidsonian elements, given the facts of verbal modification that we've already observed. Sets of primitive propositions, on the other hand, fare somewhat better. If Michael kisses LaToya at 8 PM on Tuesday on the veranda, then the Davidsonian element which models this eventuality is that set of propositions which are true of that eventuality. The denotation of *Michael kisses LaToya* is the set of all such sets of propositions which correspond to specific kissing eventualities. The modifier *at 8 PM* corresponds to the set of all sets of propositions which describe an eventuality which happens at 8 PM; the sets of propositions which correspond to the denotation of *Michael kisses LaToya at 8 PM* will be in the intersection of these sets, and thus principles of intersectivity discussed above are respected.

However, sets of propositions are not the perfect Davidsonian element. For instance, every set of propositions corresponding to Michael kissing LaToya will contain the proposition *Michael kisses LaToya and* $2 + 2 = 4$, and the proposition *Michael kisses LaToya and either the Earth revolves around the sun or it doesn't*, etc. As far as I can tell, this detail has no unpleasant theoretical consequences,[18] but it does introduce a certain lack of elegance. More significantly, not all sets of propositions model a Davidsonian element appropriately. For instance, a situation may be "too small"; it may be the singleton set of the proposition *Michael kisses LaToya*, without specifying any information about the time, location, manner, etc. of the kissing. A more intuitive implementation of situations is developed in Kratzer (1989). For Kripke, propositions are basic and situations are sets of propositions; for Kratzer, on the other hand, situations (and thus, worlds) are basic and propositions are sets of situations. So Kratzer avoids the issue of superfluous disjuncts by making situations basic, and at the same time eliminates the possibility that situations might be too small, since a primitive situation of Michael kissing LaToya cannot help but carry the information about the time, place, etc., of the kissing. However, in this latter view, situations (and propositions) cannot be quite as fine-grained as in Kripke's account; for example, if it is not possible for p to hold without q holding, then every situation which supports p will support q and vice versa; in Kratzer's terms, these propositions *lump* each other. So two propositions the truth of each of which is a necessary consequence of the other cannot be distinguished.

Now, it would be a gross misrepresentation to represent the development of situations as motivated at all by Davidsonian considerations. In fact, it seems quite the opposite; from reviewing the literature, it appears to me that the value of situations to Davidsonian semantics is a very happy accident.[19] Nevertheless, it may be possible to adopt Kratzer's situations as our Davidsonian element.[20] One potential problem with this identification follows from the lumping properties of Kratzer's account. For instance, the slice of any world which supports the truth of (2.41a) also supports the truth of (2.41b):

(2.41a) LaToya bought the guitar from Michael.
(2.41b) Michael sold the guitar to LaToya.

If Davidsonian elements have the relatively coarse granularity found in Kratzer's account, then we cannot distinguish buying from selling.[21] Do we need to make this distinction? I will return to this issue in Chapter 8 below.

2.5.2 *Complex entities as Davidsonian elements*

If we do need to make this distinction, we might turn to more complex objects for our Davidsonian elements. If we want to rely on situations, we might attempt to augment them with ways of distinguishing between them; for instance, we might assume a set of *types*, constructed out of primitive predicates and individuals, which identify what the situation is intended to be about. Barwise and Etchemendy (1987) take propositions to be pairs of situations and types; we might adopt some situations with some analogous "decoration" as our Davidsonian element.

This sort of decoration of situations has echoes in numerous places in the literature. Landman (1989b), for instance, relates the nonsubstitutivity of buying and selling with the nonsubstitutivity of CNs in general. For instance, if Michael is both the hangman and the judge, it would still be incorrect to infer (2.42b) from (2.42a):

(2.42a) The judge is on strike.
(2.42b) The hangman is on strike.

What (2.42a) claims, for instance, is that the judge, *as a judge*, is on strike. Landman implements these expressions as "aspects" of individuals, that is, filters on the set of properties which given extensional individuals have. Landman (1993) attributes a similar idea to Bartsch (1981) and Whitehead (1929). All of these related proposals raise some fairly troubling issues. For instance, while there are a large number of "role" CNs which motivate this analysis of nominal aspects, the evidence for verbs is far more limited; while we might need this structure to distinguish buying from selling, there is typically no active lexicalization corresponding to the passive of *hit* or *praise* which would cause the same problem to arise for hitting or praising events. Dowty (1991) provides a good deal of insight into this asymmetry; yet, even if the asymmetry is motivated, it seems that an enormous amount of extra architecture would need to be invoked for a relatively small number of cases.

2.6 Conclusion

Like Landman, all I require of my analysis is that there be some plausible level of representation of what happens or holds which is divisible into discrete units according to some plausible metric, and that these units be more fine-grained than at least times or locations, and perhaps other things as well. The least insightful hypothesis of the ones we're considering is that events are a subset of the domain of individuals, and otherwise unanalyzed. Furthermore, in terms of additional architecture this proposal seems to have no particular advantage over, say, the interpretation of Davidsonian elements as complex objects. Nevertheless, making a choice between these possibilities is in many ways irrelevant to this thesis. At various points, properties of events might arise which will favor some of these proposals over others, and I will address these issues when it is appropriate. For my purposes, then, I will assume that the Davidsonian element is either a situation, a situation augmented with some further distinguishing element, or a primitive event, and throughout the remainder of the thesis I will refer to Davidsonian elements as *events* when their specific properties are not important to the discussion.

Notes

[1] Actually, even color adjectives have some element of contextual dependence. For instance, a white man isn't really white, white wine isn't really white, red hair or red wine isn't really red, etc. This seems to be a different phenomenon than the case of *long*, since although color adjectives might admit some conventional uses, their senses do not vary with respect to every head in the way that scalar adjectives do.

[2] The scalar adjectives can also participate in intersective readings, as I will show below, but it is not necessary for them to do so. For a related discussion of intersective adjectives, see Keenan and Faltz (1985).

[3] It was originally believed that both scalar and intensional adjectives failed to support permutation and drop. In the scalar case, for instance, the modified CN was taken to be the comparison class against which the adjective was evaluated. It seems now that scalar adjectives can be analyzed as relying on a contextually defined comparison class which is not necessarily the head noun. The most obvious way to see this point is to observe that scalar adjectives can occur predicatively without any overt comparison class:

(i) LaToya is tall.

Other arguments to this effect can be found in Kamp (1975) and in unpublished work by Kamp and Partee. Interestingly, this argument can perhaps be extended to a subset of intensional adjectives as well, specifically those corresponding to fakery. Intensional adjectives which involve time or judgment do not follow this generalization:

(iia) That gun is fake/phony.
(iib) *That senator is former/current/future.
(iic) *That criminal is alleged/supposed/accused.

I am not aware of this parallel between scalar and *fake*-class intensional adjectives having been pointed out in print. This observation has also been made by Jacobson (p.c.).

[4] For instance, comparatives and superlatives must precede most other adjectives, although it's not clear what principle induces this ordering:

(ia) greatest American hero
(ib) better Chinese food

(ic) *American greatest hero
(id) *Chinese better food

[5]While Landman does not describe what he intends by the set of events denoted by *in the back*, I assume that it is that set of events where the "locus of activity" is located in the back of the relevant individual. The denotation of *in the back* is further complicated by the fact that definite NPs referring to body parts of specific individuals seem restricted to uses where the individual is the target of some propelled object:

(ia) Caesar was shot/stabbed/hit/struck in the back.
(ib) Caesar fell/landed/has a pain in his/*the back.

In other words, this modifier denotes some subset of a specific subset of the universal set of events. Jacobson (p.c.) questions the "intersectiveness" of modifiers like *in the back*, on the grounds that such a modifier is restricted in its distribution in this way. This sort of restriction does not trouble me at all. Almost every modifier imposes *some* selectional restrictions on its modifiee. For instance, the temporal modifiers *for an hour* and *in an hour* are well known to select for unbounded and bounded events, respectively (Dowty, 1979; Krifka, 1989), yet there is no other reason to believe that these constituents are not intersective modifiers:

(2.42a) LaToya ran for/*in an hour.
(2.42b) LaToya ran a mile in/*for an hour.

The intersective account is extremely well suited for imposing these sorts of restrictions, since each element in the intersection set must satisfy each predicate in the conjunction (and as a precondition, meet the selection requirements of each predicate as well). I will not attempt to develop a theory of selectional preconditions here; cf. Krifka (1989) for a proposal.

[6]Landman's example is a little different, and I think not quite as clear.

[7]Landman's original example does not contain *at the same time*, but he clearly intends it, and the argument requires it.

[8]This might seem a little circular, since I just defined events as elements which were of the appropriate granularity; but there is also some consideration of plausibility of discreteness, which I think rescues the argument from being entirely negative. For instance, Krifka (p.c.) points

out that these frequency adverbials impose some restrictions on the process of individuation; *Mary danced twice* cannot describe a division into half hours of a dancing by Mary from 1 to 2 PM, for instance.

[9]This range of cases, where there is a multiple and equal number of events and locations but a single time, can present some difficult problems. Assume the frequency adverbial matches the number of events and locations but not the number of times (namely, one). Unless the number of locations is ambiguous (as in (2.16)), any argument against counting locations is automatically an argument against counting events, and vice versa. So consider the situation where I take a group photograph of my coworkers, and they all blink at the flashbulb. I find (i) extremely odd in this circumstance, although if *several times* can count locations there ought to be nothing wrong with it:

(i) I made a coworker blink several times today.

Of course, since the intended situation has exactly as many blinking events as blinking locations (and blinking coworkers), then if (i) is odd, we've (apparently) shown that *several times* can't be counting either events *or* locations. Consider another scenario, where a Latin teacher successfully teaches a class of twenty students the first nominal declension. The following sounds very odd:

(ii) Twenty times today, a student learned the first nominal declension.

Do these examples mean that we can't be counting events *or* locations? We've convincingly ruled out times above; if we rule out events and locations as well, it seems like we've ruled out everything we *could* be counting. Fortunately, these examples, like Landman's, ignore issues of granularity. I think that what makes (i) and (ii) odd in the given situations is that they are each in some sense a collective action; while individual people are blinking, and individual students are learning, each is reacting as a group to a single action: a single flashbulb, a single instance of instruction. So consider a publicity shoot before the Super Bowl, where photographers are taking pictures of athletes. In such a situation, (iii) is fine, even if the athletes blink simultaneously:

(iii) A photographer made an athlete blink several times today.

Similarly, if the twenty students in question are being tutored individually, or are using a computer program individually, (ii) is much improved, even if all the students succeed simultaneously. So an example like (i) is a red herring, and once we factor out the sort of "pseudo-collectivity" which seems to be confounding these cases, we can return to the point where these examples still do not choose between locations and events.

[10]For further discussion of adverbial orientation, see Chapter 8.

[11]Rothstein's account incorporates thematic roles, which as far as I can tell are superfluous. Here, I recast her account in pure Davidsonian terms.

[12] My judgments are unclear for the "redundant" *always* here. With respect to *whenever*, Krifka (p.c.) suggests that it, too, is a non-quantificational subordinating element. Yet like *every time*, *whenever* has strong preferences about the quantificational force it's associated with; it is best construed with universal or generic quantification, and almost impossible to construe with downward-entailing operators:

(i) Whenever the bell rings, Mary always/(?)usually/*seldom/*never opens the door.

I conclude that the issue of how quantificational force is determined, and whether elements like *whenever* are quantificational or not, is still very much an open question.

[13]For instance, while I'm not exactly sure I agree with Chierchia's judgments on (2.31a) and (2.31b), my intuitions about (2.32a) and (2.32b) feel identical to the first two.

[14]I do not mean to imply that these elements are synonymous. In particular, I believe that *when* is associated with existential quantificational force, while *whenever* is associated with universal quantificational force. Cf. the discussion in Chapter 5 below.

[15]I distinguish between propositions and Davidsonian elements in Section 2.5 below.

[16]These observations leave us with an interesting question about the nature of the pronominal eventuality reference. Consider the contrast between (2.42a) and (2.42b):

(ia) Every cat thinks that it is the center of the universe.
(ib) When a cat falls, it usually lands on its feet.

In (2.42a), the pronoun *it* is within the scope of the universal quantifier corresponding to the subject NP, and is typically interpreted straightforwardly as a bound pronoun. The pronoun *it* in (2.42b), on the other hand, is a so-called "donkey" pronoun, which is not so clearly an instance of a bound pronoun. The reason is that *it* in (2.42b) apparently refers to an entity which in traditional analyses would have been "closed off" by existential quantification. The surface evidence of this closure in the classical analysis is the presence of the indefinite article *a(n)*, whose interpretation is taken to be a function from predicates to generalized quantifiers. Three basic solutions to this problem have been addressed in the literature. First, one might deny that the indefinite article has quantificational force (Heim, 1982); in such an account, the existential force of indefinites is realized by an operation of existential closure, which has the effect of reducing donkey pronouns to bound pronouns. Second, one might interpret the indefinite article as a "dynamic" existential quantifier which makes available the element it binds for subsequent reference (Groenendijk and Stokhof, 1991; Chierchia, 1992); one implementation of this strategy extends the scope of the existential quantifier, once again reducing donkey pronouns to bound pronouns. Finally, one might interpret the pronoun as a sufficiently specific definite description (Heim, 1990). The important generalization about all these solutions is that in none of these analyses except Chierchia's is the pronoun in the scope of a quantifier corresponding to the indefinite article.

So is the event-referring pronoun in (2.36c) a simple bound pronoun, as in (2.42a), or a donkey pronoun, which may or may not be a bound pronoun? It's very hard to tell. In Rothstein's analysis, for instance, the universal quantifier in the adjunct phrase clearly has the main clause within its scope, and so the natural interpretation of the pronoun is as a bound pronoun. My only goal here is to point out the question; determining the answer is not relevant to the issue of establishing reference to events.

[17]Another possible alternative is Montague's construction of events as properties of moments of time, defined intensionally in Montague (1969).

[18]I am indebted to Peter Lasersohn (p.c.) for leading me to this conclusion.

[19]The two properties of situations which have been appealed to in more traditional situation-theoretic work are their growth properties (that

is, what work can the relationship between situations of different sizes do for us; cf. Landman (1986) for an insightful discussion) and their lumping properties (cf. Kratzer (1989) for an insightful discussion). I will return to the growth properties of situations in Chapter 5; I will return to the lumping properties of situations in Chapter 8.

[20]This conclusion is close to that drawn by Lasersohn (1988), who states says that he understands events to be "something like partial possible worlds" (p. 187, fn. 7).

[21]This point is also made by Carpenter (1989).

Chapter 3

Events, Quantification and Plurality

Having established the importance of events in semantics, I must return to classical considerations. As we will see in this study, the account of events interacts intimately with considerations of quantification and plurality which have been explicated in the event-free account of semantics over the last several years. In this chapter, I will review these classical considerations and begin to show how they interact with event-based semantics.

3.1 Generalized quantifiers

One of the matters which must be readdressed in an event semantics is the account of generalized quantifiers. The original insight behind generalized quantifiers (Montague, 1973; Barwise and Cooper, 1981) is that it is possible to generalize the accounts of the determiners *every* and *some*, which are definable in terms of the logical symbols $\forall$ and $\exists$, to determiners like *most* and *more than half*, which are not. Consider the following meanings of *every* and *some*:

(3.1) $[\![\text{every}]\!] = \lambda P \lambda Q[\forall x(P(x) \rightarrow Q(x))]$

(3.2) $[\![\text{some}]\!] = \lambda P \lambda Q[\exists x(P(x) \wedge Q(x))]$

If we ignore the logical symbols these determiners are defined in terms of, and concentrate on their logical types, we see that the meanings of *every* and *some* here are relations among sets, just as transitive verbs in the classical account denote relations among individuals. The particular relation which *every* corresponds to is the subset relation; *every boy runs* is true if the set of boys is a subset of the set of runners. The particular relation which *some* corresponds to is the overlap relation; *some boy runs* if there is a non-null intersection between the set of boys and the set of runners. The account of generalized quantification proposes that the meanings of all determiners, whether or not they are expressible in terms of $\forall$ and $\exists$, are relations among sets. So *most P Q* is true iff the intersection of P and Q represents some large proportion of P; *more than half P Q* is true iff the intersection of P and Q contains more than half of the elements of P; and *ten P Q* is true iff the intersection of P and Q contains ten elements.

But what happens when we add events? The standard account of generalized quantifiers relies implicitly on the assumption that CNs and IVs have the same extensional type: sets of individuals. But in a Davidsonian event semantics, IVs denote sets of pairs of individuals and events. This contrast was illustrated in (1.1) in Chapter 1:

(1.1a) Classical: $[\![\text{run}]\!] = \lambda x[run'(x)]$
(1.1b) Davidsonian: $[\![\text{run}]\!] = \lambda x \lambda e[run'(x)(e)]$

As we will see below, the compositional neo-Davidsonian strategy departs even more radically from the classical account. Any event-based account of semantics will have to address the established insights about generalized quantifiers.

3.2 Generalized conjunction

A second consideration is the general account of conjunction. In Montague's original fragment, conjunctions like *and* were defined syncategorematically, category by category:

(3.3) $[\![\text{S}_1 \text{ and } \text{S}_2]\!] = [\![\text{S}_1]\!] \wedge [\![\text{S}_2]\!]$

(3.4) $[\![\text{VP}_1 \text{ and } \text{VP}_2]\!] = [\![\text{VP}_1]\!] \cap [\![\text{VP}_2]\!]$

However, a number of researchers since then, for instance Gazdar (1980), Partee and Rooth (1983), and Keenan and Faltz (1985), have observed that the definition of conjunctions like *and* can be generalized and stated recursively. In the discussion below, I will follow the presentation of Partee and Rooth (1983). The eligible types are given in (3.5), and the definition of generalized conjunction is given in (3.6):

(3.5a) t is a conjoinable type
(3.5b) if b is a conjoinable type, then for all a, $\langle a, b\rangle$ is a conjoinable type

(3.6a) $X \sqcap Y = X \wedge Y$ if X and Y are of type t
(3.6b) $X \sqcap Y = \{\langle z, X' \sqcap Y'\rangle : \langle z, X'\rangle \in X$ and $\langle z, Y'\rangle \in Y\}$ if X and Y are of conjoinable types other than t[1]

So any type which "ends in t" is conjoinable, with t being the base case. It's easiest to understand (3.6b) in the following way. If X and Y are functions which ultimately yield t, then for all z such that $X' = X(z)$ and $Y' = Y(z)$, $[X \sqcap Y](z) = X' \sqcap Y'$. We can eliminate X' and Y' from this equality:

(3.7) $[X \sqcap Y](z) = X(z) \sqcap Y(z)$

If we abstract over z on each side of this equivalence, we get another useful equivalence:

(3.8) $X \sqcap Y = \lambda z[X(z) \sqcap Y(z)]$

So the effect of (3.6b) is to distribute the argument of the generalized conjunction over the conjuncts. The following examples will illustrate the effect:

(3.9) $[\![$love and hate Jermaine$]\!]$ =
$[love' \sqcap hate'](j) =$
$love'(j) \sqcap hate'(j)$

(3.10) $[\![$LaToya loves and hates Jermaine$]\!]$ =
$[love'(j) \sqcap hate'(j)](l) =$
$love'(j)(l) \sqcap hate'(j)(l) =$
$love'(j)(l) \wedge hate'(j)(l)$

(3.11) $[\![$teacher and scholar$]\!]$ =
$teacher' \sqcap scholar' =$
$\lambda x[teacher'(x) \sqcap scholar'(x)] =$
$\lambda x[teacher'(x) \wedge scholar'(x)]$

(3.12) ⟦temperamental and fussy musician⟧ =
$[temperamental' \sqcap fussy'](musician') =$
$temperamental'(musician') \sqcap fussy'(musician') =$
$\lambda x[temperamental'(musician')(x) \sqcap$
$fussy'(musician')(x)] =$
$\lambda x[temperamental'(musician')(x) \wedge fussy'(musician')(x)]$

In particular, (3.12) reinforces the point that it is semantic (not syntactic) arguments which are distributed; since modifiers are functions over their modifiees, the CN is distributed across the conjoined adjectives in (3.12).

Naturally, the insights of generalized conjunction ought to be transferable to an event semantics. However, the study of conjunction in general is more complex than the account I've just presented, and in fact it will turn out that event-based semantics is entwined with the proper account of conjunction and of the semantics of plurals and distributivity. In order to show these interconnections, I must turn first to the study of plurals, and then return to the interaction between of conjunction and event semantics.

3.3 Coordinated individuals

The problem is that it isn't only constituents whose basic types "end in t" which can conjoin. We can conjoin individuals with each other, and with constituents like generalized quantifiers which are functions:

(3.13) LaToya and Michael ran.

(3.14) LaToya and every boy ran.

In an extensional version of the strategy in PTQ (Montague, 1973), NPs like *LaToya* are assigned the type $\langle\langle e,t\rangle,t\rangle$, a "raised" type, which is identical to that of generalized quantifiers. So proper nouns can be conjoined with each other and with generalized quantifiers:

(3.15) ⟦LaToya and Michael⟧ =
$\lambda P[P(l)] \sqcap \lambda P[P(m)] =$
$\lambda P[P(l) \sqcap P(m)] =$
$\lambda P[P(l) \wedge P(m)]$

(3.16) $[\![\text{LaToya and every boy}]\!] =$
$\lambda P[P(l)] \sqcap \lambda P[\forall x(boy'(x) \rightarrow P(x))] =$
$\lambda P[P(l) \sqcap \forall x(boy'(x) \rightarrow P(x))] =$
$\lambda P[P(l) \wedge \forall x(boy'(x) \rightarrow P(x))]$

An alternative to this account is the type-shifting account of Partee (1986), in which semantic objects "live" in their lowest type. The lowest type for *LaToya* is e, and it can be raised to the type of generalized quantifiers by applying a type-shifter:

(3.17) $l \Rightarrow \lambda P[P(l)]$

So what distinguishes Partee's account from the original account of Montague? We can coordinate NPs whose lowest type is e by lifting them to the type of generalized quantifiers, but it seems so far that we've gained nothing by "lowering" the basic type of proper nouns. However, we have yet to explore the full range of coordinate constructions.

3.4 Plurals

As a first step toward exploring this larger range of constructions, consider the following paradigm:

(3.13) LaToya and Michael ran.

(3.18a) Michael ran.
(3.18b) LaToya and Michael met.
(3.18c) *Michael met.

Given the tools we've seen so far, in (3.13) we can only conjoin proper nouns if they have the type of generalized quantifiers. In such an account, the denotation of the VP is distributed across the raised conjuncts of the subject (cf. (3.15)):

(3.19) $[\![\text{LaToya and Michael ran}]\!] =$
$\lambda P[P(l) \wedge P(m)](run') =$
$run'(l) \wedge run'(m)$

However, (3.18b) cannot be handled in the same way. In particular, (3.18c) demonstrates that *meet* cannot be predicated of the individual conjuncts in (3.18b). We can extend the range of data further by demonstrating that this paradigm is not merely a property of coordination, but rather a property of plurals in general:

(3.20a) One person slept.
(3.20b) Two people slept.
(3.20c) *One person met.
(3.20d) Two people met.

This question is relevant for event-based semantics because the "mode of participation" in sleeping events seems profoundly different than meeting events. It seems that if two people sleep, then it must be the case that each of them slept, since it seems to make no sense to talk about a collective act of sleeping, one whose efforts must be achieved by a group. Conversely, it seems impossible to talk about an single person meeting; (s)he must meet another person. We will call the former type of participation *distributive*, the latter *collective*. So what can the event-based semantics and the semantics of plurals each tell us about the other?

One early hypothesis, exemplified by Bennett (1974), was that NPs in collective participation have a different logical type than NPs in distributive participation. Since VPs encode the type of their arguments in their own types, a type contrast between collective and distributive NPs must correspond to a type contrast between collective and distributive VPs. In Bennett's proposal, for instance, distributive VPs are of type $\langle e, t\rangle$, while collective VPs are of type $\langle\langle e, t\rangle, t\rangle$ (that is, predicates over sets rather than individuals). In such an account, plural NPs which are distributive subjects presumably embody some operator which ensures that it is the individual elements, not the group as a whole, whose membership in the VP denotation is checked.

What happens, though, when we pair such an analysis with the Partee/Rooth/Keenan/Faltz/Gazdar account of generalized conjunction? Remember that coordinations of functions distribute their arguments over the conjunct functions. If distributive and collective VPs denote objects of different types, there should be no argument which satisfies both conjuncts, and it ought to be in principle impossible to coordinate them; at the very least, such coordinations ought to always be false. However, this prediction is wrong, as noted by by many people, including Roberts (1987):

(3.21) These cars were put together in Malaysia and sent to different countries in Europe.

Under the account of generalized conjunction (and in fact, under almost anv other account of VP conjunction), the (elements of the) plural subject *these cars* must be in the extension of plural distributive predicate *be put together in Malaysia* and the collective predicate *sent to different countries in Europe*. Since for Bennett, these predicates denote objects of different types, this overlap is impossible.

But groups of individuals clearly play a role as indivisible participants in collective action, as in (3.18b); perhaps groups are not of a different logical *type* than simple individuals, but differ in some other way, one which allows us to address (3.21). On this conclusion there seems to be broad agreement. The majority of the proposals since Bennett's (Link, 1983; Landman, 1989a; Lasersohn, 1988; Lasersohn, 1990; Lasersohn, 1995; Ojeda, 1991; Scha, 1984; Hoeksema, 1983; Krifka, 1989; Krifka, 1990b; Krifka, 1992; Schwarzschild, 1991)) agree that what we're calling individuals stand at the bottom of a *hierarchy* of individuals. In the lattice-theoretic sense, they are the *atoms*. Groups are built out of these atoms, either directly or indirectly. There is a range of proposals available; they vary according to issues like whether groups can be elements of other groups, and what the ontological status of groups is.[2] After I lay out the alternatives, I will briefly discuss what's at stake in each case.

- For Link, Ojeda, and Krifka, individuals can be subparts of other individuals, but not members of other individuals. Those individuals which have no proper subparts are the atoms; those individuals which can be constructed entirely of atoms are what we think of as groups. So *LaToya* denotes an atom, which is a subpart of the nonatom denoted by *Michael and LaToya*. Similarly, the nonatom denoted by *Michael and LaToya* is a subpart of, but not a member of, the nonatom denoted by *Michael and LaToya and Jermaine and Janet*. Thus group structure is nonrecursive, and only one level deep. The portion of this domain constructed out of the atoms is isomorphic to a powerset algebra. I will call this the *one-level sum* account.

- For Schwarzschild, groups are sets, but there are no sets of sets, and thus no groups which are members of other groups. So everything in his domain of individuals is built out of atoms. Thus, Schwarzschild's domain is also a powerset algebra, and his group structure is only one level deep. I will call this the *one-level set* account.

- For Hoeksema, Landman, and Lasersohn, groups are sets, and they can be members of other groups. The universe of individuals is recursively structured, with the groups at one level serving as the individuals at the next level. This group structure is potentially infinitely recursive.[3] I will call this the *multi-level set* account.

Missing from the paradigm is any notion of a *multi-level sum* account. As far as I can tell from the formal properties of sums, this notion is incoherent. The sums of Link and Ojeda are lattice-theoretic objects, and since the lattice-theoretic join operation is associative, $a + (b + c) = (a + b) + c$, and thus there can be no meaningful internal boundaries within a sum.

As I pointed out above, if we restrict ourselves to looking at the behavior of atoms, the one-level sum account is isomorphic to a powerset algebra, thus to the one-level set account. However, for mass nouns, the one-level sum account is preferable to the one-level set account, because in the one-level sum account, not everything must be built out of atoms. We can model mass nouns, for instance, as denoting sets of individuals which cannot be decomposed into atomic parts. This account allows us to capture some of the parallels between mass nouns and plurals, for example in cooccurrence with determiners:

(3.22a) some boys
(3.22b) some water
(3.22c) *some boy (on the "unspecified quantity" reading)

Since mass nouns, like plurals, denote nonatoms, we can require determiners like *some* to select sets of nonatoms. This parallel cannot be represented in the same way in the set account, because sets are constructed out of individuals and must be decomposable into individuals by definition.

However, the set account does have a potential advantage over the sum account, because within the set account it is possible to distinguish multiple levels of plurality. Lasersohn (1995) argues extensively that there are a number of cases where we must refer to subparts of plurals which do not correspond to individuals. For instance, the element *both* applies felicitously only to plurals with two elements:

(3.23a) Both John and Mary are asleep.
(3.23b) Both children are asleep. (acceptable only if there are exactly two children)

(3.23c) *Both John, Mary, and Lisa are asleep.

If this generalization is correct, what are we to make of (3.24)?

(3.24) Both the boys and the girls are asleep.

The only explanation available to us is that *the boys and the girls* is a set of two elements: the set of boys and the set of girls. In the multi-level set account, this internal structure is easily constructed; in the sum account, on the other hand, there is no internal structure, so a parallel account of *both* is impossible in that theory.[4]

In this thesis, I will be concerned neither with the semantics of these complex plurals nor with the semantics of mass nouns. I will adopt a one-level sum account in much of the discussion to follow, both because a one-level account is simpler and because a sum account maintains a rigid mechanical distinction between predicates (which are sets in either account) and plurals (which are sets in the set account, nonatomic individuals in the sum account). We can characterize a representative weak version of this proposal by assuming:

- an associative, reflexive, commutative, idempotent join operator, which I will notate as $+$;
- a part-of relation $\leq$, defined so that for all x and y, $x \leq y$ iff $x + y = y$;
- the domain of individuals D, which is closed under the join operator;
- a subset of D of atomic individuals At, defined so that for all x in At, $\neg\exists y(y \in D \wedge y \leq x \wedge y \neq x)$ (there are no elements in D smaller than x).

There is one final contrast among theories of individuals which I wish to take a position on. There are two primary schools of thought about what the lattice-theoretic join operation does. The first is what I will call the *liberal* account, which would extend the join operation to represent the member-of relation and the physical part-of relation as well. So *committee* might be a taken to be a set of sums of committee members; one proposal in this vein is Landman (1989a; 1989b). More radically, one might take objects to be lattice-theoretic sums of their parts, so that table legs are lattice-theoretic parts of tables, etc. In such a framework, At is not a set, but rather a relation among sets, since individuals are no longer atomic or not in their own right but only with respect to a certain predicate; if Jermaine and Michael form a committee, then their sum is atomic with respect to $committee'$ but not with respect to $person'$.

I will call the second position the *conservative* account. In this account, committees and their members, tables and their legs, are all atoms, and the member-of and part-of relations which relate them has nothing to do with the lattice-theoretic join operation which supports plurals and conjunction. With respect to the member-of relation, this position is endorsed by Barker (1992). In this position, At is simply a set of individuals. In this thesis, I will adopt the conservative account, both for objects and, eventually, for events.

3.5 Putting the pieces together

With these tools in hand, we may now return to the relationship between plurals and distributive and collective participation. Let's return to (3.20b) and (3.20d):

(3.20b) Two people slept.
(3.20d) Two people met.

In order to account completely for these cases, we must account for the semantics of plural CNs, of cardinal numbers, and of distributive and collective predicates. In the remainder of this section, I will sketch a representative account.

For instance, what does *people* denote? The account I will choose follows Link (1983), Landman (1989a) and others in viewing singular count nouns as denoting sets of atomic individuals and plural count nouns as the closure of those atomic individuals under the $+$ operator:

(3.25a) $[\![\text{person}]\!] = \{p_1, p_2, p_3, \ldots\}$
(3.25b) $[\![\text{people}]\!] = \{p_1, p_2, p_3, p_1 + p_2, p_2 + p_3, \ldots\}$

Note that the denotations of plural count nouns include the atoms. This might seem strange, but there are good reasons for adopting this position, which I will defer until Section 3.6.

The next piece of the puzzle is the meaning of cardinal numbers like *two* or *ten*. These are sometimes taken to denote functions from CNs to generalized quantifiers, but this type assignment is inconsistent with their cooccurrence with other generalized quantifiers such as *no*:

(3.26) No two children hit each other.

Instead, I will follow Verkuyl (1981), Hoeksema (1983), Bunt (1985), Partee (1986), Link (1987), Krifka (1989) and Eschenbach (1993) in treating cardinals as essentially adjectival. Cardinals intersectively modify sets of individuals by imposing some restriction on the number of atoms which comprise it. First we extend the size operator $|\ |$ on sets to include (possibly complex) individuals built out of atoms. In this case, the size of such individuals is defined to be the size of the set of atoms which the individual contains:

(3.27) For any individual x, $|x|$ is the positive integer described by $|\{y|y \in At \wedge y \leq x\}|$

(3.28) $[\![\text{two}]\!] = \lambda P \lambda x[P(x) \wedge |x| = 2]$

So *two people* is the set of all individuals in the set of people built out of two atoms.

Finally, we turn to the VP. What accounts for the asymmetry between distributive predicates like *sleep*, which allow both atoms and nonatoms as subjects, and collective predicates like intransitive *meet*, which only permits nonatoms?

Researchers such as Lasersohn (1995) have argued persuasively that the distinctions that lead to these various readings must be located in the VP, not the NP. But what is the nature of these distinctions? We might naively hypothesize that the denotation of the VP *sleep*, since it's distributive, contains only atoms, and the denotation of the VP *meet*, since it's collective, contains only nonatoms. But this hypothesis says nothing about how nonatoms can be the subject of *sleep*, and it says nothing about how the two different types of VPs can be fruitfully coordinated, as we saw in (3.21) above:

(3.21) These cars were put together in Malaysia and sent to different countries in Europe.

Recall that if we assumed that singulars and plurals denoted different *types* of entities, this coordination was blocked by the type mismatch.

However, the problem is no less damning now; our naive hypothesis predicts that the intersection of the denotations of any pair of distributive and collective VPs will be empty. So what else must we say?

A range of solutions to this proposal has been laid out in the literature, but they all share the idea that nonatoms must be added somehow to the denotations of distributive VPs. For Lasersohn, for example, these nonatoms are present by virtue of the definition of the predicate in question; so $sleep'$ is that set of individuals such that each atomic subpart of that individual sleeps. For Roberts (1987) and Link (1983), these nonatoms are contributed by some operator which closes a VP denotation under the $+$ operator. Either way, *were put together in Malaysia* will contain the sums of the cars each of which was put together in Malaysia, and it is those nonatoms which are both sums of such cars and sent to different countries in Europe which will be in the denotation of the conjoined VP:

(3.29) $[\![$be put together in Malaysia$]\!] = \{c_1, c_2, c_1 + c_2, \ldots\}$

Can we now account for the semantics of (3.20b) and (3.20d), repeated here?

(3.20b) Two people slept.
(3.20d) Two people met.

Not quite yet. There is one small piece missing. Recall that we've abandoned the analysis of cardinal numbers as generalized quantifiers. So somehow, we must introduce an existential quantifier over these sets of nonatomic individuals like *two men*. One might object that we only need to do this because we've misanalyzed *two* as a modifier rather than a determiner, but we've already seen that cardinals can cooccur with true determiners like *no*, and we can also observe that such an existential quantifier is needed for bare plural CN arguments of stage-level predicates:

(3.30) Dogs barked.

Partee (1986) proposes her type-shifter A (so named for its close resemblance to the classical denotation for the indefinite determiner) as a suitable candidate:

(3.31) $A = \lambda P \lambda Q[\exists x(P(x) \wedge Q(x))]$

We finally have all the pieces. We can now provide an account of (3.20b) and (3.20d). We begin with the denotation of *two people*:

(3.32) $[\![\text{two people}]\!] =$
$\lambda x[people'(x) \wedge |x| = 2] =$
$\{l + m, m + j, \ldots\}$

Because of the closure operation, the denotation of *sleep* will contain, in addition to the atoms corresponding to individuals who sleep, all the sums of such atoms:

(3.33) $[\![\text{sleep}]\!] = \{l, m, l + m, \ldots\}$

The denotation of *meet*, on the other hand, includes groups without the intervention of the closure operator, since it is "basically" true of groups and not individuals:[5]

(3.34) $[\![\text{meet}]\!] = \{l + m, \ldots\}$

Putting all the pieces together, we can construct the denotation of *Two people slept* and *Two people met*:

(3.35) $[\![\text{two people slept}]\!] =$
$A(\lambda x[people'(x) \wedge |x| = 2])(sleep') =$
$\lambda P \lambda Q[\exists x(P(x) \wedge Q(x))](\lambda x[people'(x) \wedge |x| = 2])(sleep') =$
$\exists x(people'(x) \wedge |x| = 2 \wedge sleep'(x))$

(3.36) $[\![\text{two people met}]\!] =$
$A(\lambda x[people'(x) \wedge |x| = 2])(meet') =$
$\lambda P \lambda Q[\exists x(P(x) \wedge Q(x))](\lambda x[people'(x) \wedge |x| = 2])(meet') =$
$\exists x(people'(x) \wedge |x| = 2 \wedge meet'(x))$

3.6 Generalized sum conjunction

At this point, we have some notion of what plurals are, and how distributivity and collectivity are related to them. But what can we now say about conjunctions of proper nouns? That is, do we have the tools to say something about what's going on when we conjoin proper nouns? Let's return to the cases which inspired this discussion:

(3.13) LaToya and Michael ran.

(3.18b) LaToya and Michael met.

So what does *LaToya and Michael* denote? The obvious answer, given an account of plurals, is that *LaToya and Michael* denotes the sum of LaToya and Michael, and that *and* is ambiguous between the generalized conjunction operator $\sqcap$ and the join operator $+$. But conjunctions of NPs aren't the only cases which need to be handled specially. For instance, consider the conjoined CN *men and women* in the NP *ten men and women*. CNs denote sets of individuals, which can be conjoined by generalized conjunction:

(3.37) $men' \sqcap women'$

However, the resulting conjunction would be the intersection of the set of men and the set of women, which is a possible reading for *men and women* (cf. *teacher and scholar* in (3.11) above), albeit extremely unlikely. There must be yet another sense of *and* which arises in CNs like *ten men and women*. What does such a CN mean? It is that set of individuals of size ten such that part of each individual is men and the rest of each individual is women. So *men and women* means the following:

(3.38) $[\![\text{men and women}]\!] =$
$\lambda x[\exists y \exists z(men'(y) \wedge women'(z) \wedge x = y + z)]$

The problem with *ten men and women* in the standard account of generalized conjunction can't be fixed with the type-shifting of Partee and Rooth (1983), either. The "normal" interpretation, assuming a modification analysis of *ten*, would be a set of plural individuals of size ten which are simultaneously men and women. If we type-raise the CNs, we end up with almost exactly the same thing:

(3.39) $\lambda P[P(men') \sqcap P(women')](ten') =$
$ten'(men') \sqcap ten'(women')$

Under the type-raised meaning, instead of a set of hermaphrodites of size ten, we get a set of plural individuals which are simultaneously men of size ten and women of size ten. However, assuming that every atomic element of an element of men' is a man, and analogously for $women'$, this result is equivalent to the previous one. If we treat *ten* as a determiner, the situation worsens considerably; while the unraised interpretation is no different than the problematic interpretation we've already encountered, if we type-raise the CNs over the determiner *ten*, we end up with a meaning equivalent to *ten men and ten women*:

(3.40) $\lambda\mathcal{D}[\mathcal{D}(men') \sqcap \mathcal{D}(women')](ten'_{det})(run') =$
$[ten'_{det}(men') \sqcap ten'_{det}(women')](run') =$
$ten'_{det}(men')(run') \sqcap ten'_{det}(women')(run')$

In other words, under the determiner analysis of *ten*, we end up asserting something of twenty individuals in this particular case. That is, neither the order of application nor the semantic type of the cardinal modifier is the problem in *ten men and women*.

If we adopt an account of coordination exemplified in (3.38), we can motivate an account of plural CNs which requires them to include the atoms, as shown in (3.25) above. *Three men and women* is that set of individuals of size three part of which is men and part of which is women:

(3.41) $[\![$three men and women$]\!] =$
$\lambda x[|x| = 3 \wedge \exists y \exists z(men'(y) \wedge women'(z) \wedge x = y + z)]$

But how big are the subparts in question? On the most likely interpretation, there are two men and one woman, or one man and two women, comprising each individual in this set. But in order for that to be the case, the denotations of plural CNs must contain atoms.

We can find other, more complex examples of this sort of sum conjunction. For instance, we saw in (3.12) above that conjoined CN modifiers could induce an intersective reading; it turns out that such modifiers can also induce the sum-oriented reading we see here in (3.38). For instance, the meaning of *and* we're already familiar with would assign to a CN like *friendly and unfriendly soldiers* that set of individuals which are both friendly and unfriendly soldiers:

(3.42) $[\![$friendly and unfriendly soldiers$]\!] =$
$[friendly' \sqcap unfriendly'](soldier') =$
$\lambda P \lambda x[friendly'(P)(x) \wedge unfriendly'(P)(x)](soldier') =$
$\lambda x[friendly'(soldier')(x) \wedge unfriendly'(soldier')(x)]$

But this intersective reading is no more plausible than the intersective reading of *men and women*. The most available interpretation of *friendly* *and unfriendly soldiers* is that set of individuals such that part of each individual is friendly soldiers and the rest of each individual is unfriendly soldiers. This interpretation implies the following interpretation of *friendly and unfriendly*:

(3.43) $[\![\text{friendly and unfriendly}]\!] =$
$$\lambda P \lambda x[\exists y \exists z(friendly'(P)(y) \wedge unfriendly'(P)(z) \wedge x = y+z)]$$

In other words, the interpretation of *friendly and unfriendly soldiers* is identical to that of *friendly soldiers and unfriendly soldiers*, where *and* is interpreted as in (3.38).

This case implies that this sort of conjunction is only partially distributive. Like the sort of conjunction we saw above, it can distribute arguments (as it does with the CN denotation here), but for sets of individuals, it creates sums. In fact, based on its resemblance to the previous account, we might conclude that we ought to generalize this sort of conjunction (which I will call *e-conjunction*, for conjunction of individuals, and notate as $\&$) in a manner analogous to the Partee/Rooth/Kee/-nan/-Faltz/Gaz/-dar generalized conjunction (which I will call *t-conjunction*).

A number of people have attempted such a generalization, among them Link (1983), Hoeksema (1988) and Krifka (1990a). However, the version which will interest us most immediately is that of Lasersohn (1995), because of its implications for event semantics.

Above, I mentioned that Lasersohn's account of plurals is a multi-level set account. Rather than introduce such an account here, I will recast his basic insight in the weaker account of plurals I've chosen. Note that the account of e-conjunction differs from t-conjunction in that while e-conjunction is defined for elements of the basic type e, the recursive aspects of its definition do not involve objects which culminate in this type. Rather, the definition for type e stands essentially on its own:

(3.44) $x \mathbin{\&} y = x + y$ for x, y of type e

I will essentially ignore this subcase in the discussion to follow. I will present the proposal in a manner parallel to that of t-conjunction in (3.5) and (3.6) above. In (3.45), I define the eligible types for e-conjunction. I will depart from Lasersohn's account and omit t and functions into t not "mediated" by $\langle e, t\rangle$ (such as $\langle t, t\rangle$) from the domain of e-conjunction:

(3.45a) $\langle e, t\rangle$ is an e-conjoinable type

(3.45b) If b is an e-conjoinable type, then for all a, $\langle a, b\rangle$ is an e-conjoinable type

In other words, the base cases for e-conjunction are predicates. Note that a ranges over all types, not just e. In (3.46) I present the definition of e-conjunction. The case where $a = e$ is distinguished for any argument position:

(3.46a) $f \mathbin{\&} g =$
$\{z|\exists x\exists y(z = x + y \wedge f(x) \wedge g(y))\}$ if f, g are of type $\langle e, t\rangle$
(3.46b) $f \mathbin{\&} g =$
$\{\langle z, h\rangle|h = \bigcup\{h'|\exists x\exists y(z = x + y \wedge h' = f(x) \mathbin{\&} g(y))\}\}$ if f, g are of type $\langle e, b\rangle$ for any b other than t
(3.46c) $f \mathbin{\&} g = \lambda z[f(z) \mathbin{\&} g(z)]$ otherwise

So clause (3.45a) corresponds to sets of individuals, and its behavior is addressed in (3.46a). Clause (3.45b) is divided between (3.46b) and (3.46c). The first subcase corresponds to multi-argument predicates the most oblique argument of which is of type e (objects of type $\langle e, \langle e, t\rangle\rangle$, for instance); just as in the base case in (3.46a), the argument filler is "split" across the conjoined elements, one part to one conjunct, the other to the other. The subcase of clause (3.45b) corresponds to the default distributive case isomorphic to t-conjunction.[6]

Here are some examples of this definition at work. In (3.47), I illustrate the base case $\langle e, t\rangle$ from (3.46a); in (3.48), I illustrate the case of a more complex predicate whose most oblique argument is of type e, from (3.46b). The latter case involves the relational nouns *friend* and *enemy*, which I will assume are of type $\langle e, \langle e, t\rangle\rangle$, following Löbner (1985) and Barker (1992).[7]

(3.47) $[\![$men and women$]\!] =$
$men' \mathbin{\&} women' =$ (clause (3.46a))
$\{x + y|men'(x) \wedge women'(y)\} =$
$\lambda z[\exists x\exists y(z = x + y \wedge men'(x) \wedge women'(y))]$

(3.48a) $[\![$friends and enemies$]\!] =$
$friends' \mathbin{\&} enemies' =$ (clause (3.46b))
$\{\langle x + y, f' \mathbin{\&} g'\rangle|friends'(x) = f' \wedge enemies'(y) = g'\} =$
$\lambda z\lambda w[\exists x\exists y(z = x + y \wedge [friends'(x) \mathbin{\&} enemies'(y)](w)]$

(3.48b) ⟦friends and enemies of Michael and LaToya⟧ =

$$[friends' \mathbin{\&} enemies'](m+l) =$$
$$\lambda z \lambda w[\exists x \exists y(z = x + y \wedge [friends'(x) \mathbin{\&} enemies'(y)](w))](m+l) =$$
$$\lambda w[\exists x \exists y(m + l = x + y \wedge [friends'(x) \mathbin{\&} enemies'(y)](w))] = \text{(clause (3.46a))}$$
$$\lambda w[\exists x \exists y(m + l = x + y \wedge \lambda z[\exists x' \exists y'(z = x' + y' \wedge friends'(x)(x') \wedge enemies'(y)(y'))](w))] =$$
$$\lambda w[\exists x \exists y(m + l = x + y \wedge \exists x' \exists y'(w = x' + y' \wedge friends'(x)(x') \wedge enemies'(y)(y')))]$$

So *men and women* denotes that set of individuals which are decomposable into men and women; *friends and enemies of Michael and LaToya*, roughly, denotes that set of individuals which are decomposable into friends of some subpart of Michael and LaToya and enemies of some subpart of Michael and LaToya.

The final clause (3.46c) involves the sort of distributivity which we recognize from t-conjunction, and is exemplified here by our old friend *friendly and unfriendly soldiers*:

(3.49) ⟦friendly and unfriendly soldiers⟧ =

$$[friendly' \mathbin{\&} unfriendly'](soldiers') = \text{(clause (3.46c))}$$
$$\lambda P[friendly'(P) \mathbin{\&} unfriendly'(P)](soldiers') =$$
$$friendly'(soldiers') \mathbin{\&} unfriendly'(soldiers') = \text{(clause (3.46a))}$$
$$\lambda z[\exists x \exists y(z = x + y \wedge friendly'(soldiers')(x) \wedge unfriendly'(soldiers')(y))]$$

So in this case at least, the function of (3.46c) is to "feed" the base case defined for $\langle e, t \rangle$.

Now, the similarity of (3.46c) to the recursive subcase of t-conjunction might seem suspicious and redundant. Lasersohn proposes to address this redundancy by eliminating t-conjunction. Let's revisit the denotation of *men and women*:

(3.38) ⟦men and women⟧ =

$$\lambda x[\exists y \exists z(men'(y) \wedge women'(z) \wedge x = y + z)]$$

Remember that $+$ is idempotent. That is, for all individuals x, $x + x = x$. Furthermore, the meaning of *men and women* given here does not require that y and z be distinct. If $y = z$, then $y + z = y = z$, and so $x = y = z$. In particular, atomic individuals, which cannot be decomposed, will always interact with the definition of e-conjunction in this way. For this subcase, (3.38) reduces to

(3.50) $\lambda x[men'(x) \wedge women'(x)]$

This, of course, is t-conjunction. So for the $\langle e,t\rangle$ case in (3.46a) (and also for the more oblique arguments of type e covered in (3.46b)), e-conjunction subsumes t-conjunction. In other words, e-conjunction is logically weaker than t-conjunction, and the contrast between the intersective and nonintersective readings of CN conjunction is a vagueness, not an ambiguity. When we assume that the subparts that the individual is divided into are identical to the individual itself, it turns out that e-conjunction, like t-conjunction, distributes its argument across its conjuncts. Since the remaining subcase of e-conjunction is identical to t-conjunction for the types it covers, what Lasersohn concludes is that t-conjunction ought to be done away with entirely.

Now, my definition of e-conjunction, unlike Lasersohn's, omits a number of types, such as t and $\langle t,t\rangle$. But this omission will not prevent us from eliminating t-conjunction in favor of e-conjunction. What Lasersohn points out is that once we introduce events into our semantics, the relevance of objects of type t vanishes, to be replaced by objects of the type of sets of events.

So far, the crucial subcase of e-conjunction has been defined only for individuals. For Lasersohn, events are individuals, a subset of D, and it is only for this domain that the lattice structure for plurality has been defined. However, we have drawn no such conclusion about the nature of events; for instance, we have left open the possibility that events are complex objects of some sort. Fortunately, nothing prevents us from simply requiring that whatever events are, they enter into the same sort of lattice-theoretic relationships that individuals do, and that all generalizations about individuals which rely on their lattice-theoretic properties extend to events as well. So let's revise our lattice-theoretic principles slightly. Instead of assuming a domain of individuals D, let's redefine D to be the union of $\mathcal{O}$, the domain of object individuals, and $\mathcal{E}$, the domain of events. Let $+_{\mathcal{O}}$ be the join operator defined over $\mathcal{O}$, and let $+_{\mathcal{E}}$ be the join operator defined over $\mathcal{E}$, and assume that $\mathcal{O}$ and $\mathcal{E}$ are closed under join as we assumed for D above. Now let $+$ be the union of $+_{\mathcal{O}}$ and $+_{\mathcal{E}}$. Finally, we must assume that the subcases of e-conjunction which refer specifically to arguments of type e apply to event arguments too. Given these assumptions, event set e-conjunction has the same properties as conjunctions of $\langle e,t\rangle$. So, for instance, conjunctions of Ss, if we treat them as denoting sets of events, are subject to clause (3.46a) of the definition of e-conjunction:[8]

(3.51) $[\![\text{Michael sings and LaToya dances}]\!] =$
$\lambda e[sing'(m)(e)]\ \&\ \lambda e[dance'(l)(e)] =$
$\lambda e[\exists e'\exists e''(e = e' + e'' \wedge sing'(m)(e') \wedge dance'(l)(e''))]$

Conjunctions of VPs end up being analogous to conjunctions of relations like *friends and enemies*:[9]

(3.52) Michael sings and dances.

(3.53a) $[\![\text{sings and dances}]\!] =$
$sing'\ \&\ dance' =$ (clause (3.46b))
$\{\langle x+y, f'\ \&\ g'\rangle | sing'(x) = f' \wedge dance'(y) = g'\} =$
$\lambda z\lambda w[\exists x\exists y(z = x + y \wedge [sing'(x)\ \&\ dance'(y)](w))]$
(3.53b) $[\![\text{Michael sings and dances}]\!] =$
$\lambda z\lambda w[\exists x\exists y(z = x + y \wedge [sing'(x)\ \&\ dance'(y)](w))](m) =$
$\lambda w[\exists x\exists y(m = x + y \wedge [sing'(x)\ \&\ dance'(y)](w))] =$
$sing'(m)\ \&\ dance'(m) =$ (clause (3.46a))
$\lambda e[\exists e'\exists e''(e = e' + e'' \wedge sing'(m)(e') \wedge dance'(m)(e''))]$

In other words, *Michael sings and dances* means the same thing as *Michael sings and Michael dances*: it is a set of complex events which decompose into Michael dancing and Michael singing. Notice here, as above, that the atomic individual argument (and potentially any individual argument) is distributed across its conjuncts.

So in some sense, we have come full circle. We began by insisting that classical solutions like generalized conjunction needed to be addressed in event semantics. We explored the semantics of conjunction and found that it led to the semantics of plurals and an ambiguity in the account of conjunction. But as we looked farther, we discovered that embracing events in semantics allows us to eliminate this ambiguity and unify the account of conjunction once again.

3.7 Distributivity, collectivity and events: a final motivation

There is a second thread which runs through the discussion just completed: the relationship between distributivity and collectivity and events. In this section, I will explore these relationships, and conclude with an argument from Lasersohn (1988; 1990; 1995) which derives crucial evidence for events from the linguistic properties of collective action.

3.7.1 Distributivity and collectivity

So far, we have examined two types of predicates: strictly distributive predicates like *sleep* which hold of every atomic part of their nonatomic arguments, and collective predicates like *meet* which hold of no atomic part of their nonatomic arguments. There is a third class of predicates, which I will call *mixed*, which are compatible with either mode of participation. Consider the paradigm in (3.54):

(3.54a) Michael and LaToya/two people washed the car.
(3.54b) Michael and LaToya/two people each washed the car.
(3.54c) Michael and LaToya/two people together washed the car.

The VP *wash the car* is compatible with either joint or individual action, so (3.54a) can be interpreted either as (3.54b) or (3.54c). As the latter two examples illustrate, the two readings can be disambiguated with the adverbial elements *each* and *together*.[10]

Now, we concluded above that distributive VPs undergo some operation which closes them under the $+$ operator, as illustrated in (3.29) and (3.33) above. Clearly, this assumption holds of mixed VPs as well, since (3.54a) has a distributive reading with a plural subject. It turns out that the mechanism which enables these plural distributive readings has further applications. Consider, for instance, the situation in which the object of *wash* is plural:

(3.55a) Michael and LaToya/two people washed ten cars.
(3.55b) Michael and LaToya/two people each washed ten cars.
(3.55c) Michael and LaToya/two people together washed ten cars.

The sentence in (3.55a) actually has three readings, not two.[11] It is indeed compatible with either the interpretation in (3.55b) and the one in

(3.55c), but (3.55c) in turn has at least two ways in which it can be understood. One reading is completely collective, where Michael and LaToya as a team collectively washed each of ten cars; we will call this reading the *team* reading. The other reading is less specific; it simply states that two people washed cars, and ten cars were washed by people, but no commitments are made about which cars are washed by which people or how many washings there were. This is the *cumulative* reading of Scha (1984); I will call this reading the *neutral* reading.

Recall that we assumed above that cardinal numbers are adjectival, and in the absence of an explicit determiner they undergo a shifting operation which provides a default existential quantifier. Given these assumptions, (3.56) is a potential interpretation for the neutral reading of (3.55a):

(3.56) $\exists x(people'(x) \wedge |x| = 2 \wedge \exists y(cars'(y) \wedge |y| = 10 \wedge wash'(y)(x)))$

One situation in which (3.55a) is true is one in which Michael washes six cars, and LaToya washes four. Then the denotation of *wash* looks like this:

(3.57) $[\![\text{wash}]\!] =$
$\{\langle m, car_1\rangle, \ldots, \langle m, car_6\rangle, \langle l, car_7\rangle, \ldots, \langle l, car_{10}\rangle, \ldots\}$

But how can (3.57) validate (3.56)? There is no tuple in the denotation of *wash* in (3.57) which contains a group of washers of size two, or a group of things washed of size ten. What we can do is extend our account of closure under the $+$ operator. A number of people have proposed such an account, which I will name *summativity*, a term I've borrowed from Krifka (1989). Summativity is essentially the closure of a set of tuples under the pairwise application of the $+$ operator.[12] I will assume that summativity applies to the denotations of all relation-denoting lexical items:[13]

(3.58) Summativity: for all relation denotations R of lexical items,
$R(x_1, \ldots, x_n) \wedge R(y_1, \ldots, y_n) \rightarrow R(x_1 + y_1, \ldots, x_n + y_n)$

So if LaToya kisses Michael and Janet kisses Jermaine, then LaToya and Janet kiss Michael and Jermaine. This proposal represents a generalization of the closure operator discussed earlier for distributive VP denotations in that closure is implemented over ordered sequences of individuals, rather than just individuals themselves. Variations of an account has been proposed in eventless accounts of semantics (Schwarzschild, 1991), Davidsonian accounts (Lasersohn, 1995; Krifka, 1990b), and neo-Davidsonian accounts (Krifka, 1989). If we adopt summativity in the case of *wash* above, then the sum of the individual washing tuples we know of in the denotation of *wash* must also be in the denotation of *wash* as well. That is, the denotation of *wash*, under summativity, must minimally look like this:

(3.59) $[\![\text{wash}]\!] =$
$\langle m, car_1\rangle, \ldots, \langle m, car_6\rangle, \langle l, car_7\rangle, \ldots, \langle l, car_{10}\rangle,$
$\langle m + l, car_1 + \ldots + car_{10}\rangle, \ldots\}$

This "derived" tuple is a washing involving two people and ten cars, and thus (3.56) is validated.

3.7.2 *The semantics of* together

together

In what way is this proposal relevant to event semantics? Let's return to the contrast between (3.54a) and (3.54c):

(3.54a) Michael and LaToya/two people washed the car.
(3.54b) Michael and LaToya/two people each washed the car.
(3.54c) Michael and LaToya/two people together washed the car.

We've observed that mixed predicates like *wash the car* contain groups by virtue of having distributive readings, on the interpretation of (3.54a) where Michael and LaToya each individually washed the car. We've also observed that mixed predicates contain groups by virtue of primitive collective action, under the interpretation of (3.54a) illustrated in (3.54c). So let's say that the tuple $\langle m + l, c_1\rangle$ is found in the denotation of *wash*. Is (3.54b) true, or (3.54c)? We have no way of knowing. In other words, given what we have proposed so far, we cannot distinguish between plural distributive participation and true collective participation in mixed predicates, due to summativity.

There have been a few attempts to fix this problem. Hoeksema (1983), for instance, proposed that what *together* does is remove the atoms from the denotations of predicates. However, as Lasersohn (1990) points out, Hoeksema's solution is oversimplistic. Although Hoeksema regards mixed predicates like *wash* as ambiguous between distributive and collective, nothing in his account prevents *together* from modifying plural distributive predicates, in which case *together* would pick out plurals which are constructed from distributive action. But (3.54c) is false in those situations where Michael washed the car by himself and so did LaToya.

Lasersohn (1988; 1990; 1995) provides a different answer. His insight relies crucially on events. Consider what happens when summativity applies to a verbal denotation in an event semantics. Events are elements of the tuples in these denotations just like any other element, and they get summed up just like any other element. So let's say that Michael washes the car, LaToya washes the car, and the two of them wash the car together. Then, without considering the effects of summativity, the denotation of *wash* is minimally

(3.60) $[\![\text{wash}]\!] =$
$$\{\langle m, c_1, e_1\rangle, \langle l, c_1, e_2\rangle, \langle m+l, c_1, e_3\rangle, \ldots\}$$

Each washing corresponds to a different atomic event individual. Now we reveal some of the effects of summativity:

(3.61) $[\![\text{wash}]\!] =$
$$\{\langle m, c_1, e_1\rangle, \langle l, c_1, e_2\rangle, \langle m+l, c_1, e_3\rangle, \langle m+l, c_1, e_1+e_2\rangle, \ldots\}$$

We see now that Michael and LaToya wash the car twice, once collectively (e_3) and once distributively ($e_1 + e_2$). But now we have a way of distinguishing those washings which satisfy (3.54b) and those which satisfy (3.54c). The former are those which correspond to nonatomic events, and the latter are those which correspond to atomic events. That is, simply by extending our semantics to embrace events, we can now distinguish among different modes of participation.

Now, what I've outlined here is a severe oversimplification of Lasersohn's account, which I will have reason to discuss in far greater detail in Chapter 7 below. Nor is Lasersohn's solution clearly more adequate than every other solution in the literature; Schwarzschild (1991) proposes an eventless account which requires a number of unusual basic assumptions, but seems to address a suitably wide range of facts (see Lasersohn (1995) for an extensive discussion of the differences between these two approaches). Furthermore, neither Lasersohn nor Schwarzschild fully tame the wide range of unusual and complex properties of *together*.

Nevertheless, I think the intuition remains clear. Participation is necessarily participation in an event. The structure of that event can clarify and specify the nature of the participation. In the remainder of this thesis, issues of distributivity and collectivity, events and participation, will arise over and over.

3.8 Conclusion

In this chapter, I have attempted to establish some relationship between the properties of plurals, quantification and conjunction on the one hand and participation and event semantics on the other. Note crucially that in the course of developing these ideas I have assumed that Davidsonian elements are subject to the same lattice-theoretic generalizations that the domain of individuals is subject to. In particular, it must be possible to identify a set of atomic Davidsonian elements and to define a join operator with Davidsonian elements as its domain. The consequence of this requirement is that events, whatever they are, behave as individuals do with respect to e-conjunction and summativity, among other things. While the simplest assumption to make is that events are actually individuals of some sort, I do not believe that this requirement chooses among the various candidates for Davidsonian elements which I've introduced; however, the observation is worth emphasizing for the discussion to follow.

Notes

[1]The equivalent definitions can be given for disjunction, but I will not concern myself with disjunction here.

[2]For the purposes of this discussion, I can afford to be relatively informal. For a detailed examination of the mathematics which lie behind these lattice structures, cf. Landman (1991).

[3] For Hoeksema and Landman, atoms are distinguished from the corresponding singleton sets; for Lasersohn, individuals and their corresponding singleton sets are equal, following the non-well-founded set axiomatization of Quine (1937). Quine's idea is nicely summarized in Schwarzschild (1991). Quine assumes that sets as well as individuals can be quantified over (and that variables are not typed), and introduces the axiom of extension, which says that two elements with the same members are equal:

(i) $\forall y \forall z(\forall x(x \in y \leftrightarrow x \in z) \rightarrow y = z)$

If this is one of our axioms of our set theory, what happens when y (or z) is an individual? It all depends on whether we assume that individuals have members. If we assume that they do not, then it will be trivially true that every element x is a member of y just in case it is a member of z (since neither y nor z have any members at all), and so the consequent of the implication will be true for all y and z. Therefore, any two individuals y and z will turn out to be equal according to this axiom. In other words, if we assume that individuals don't have members, this axiom entails that there is exactly one individual. So Quine assumes that when z is an individual, $x \in z$ is true just when $x = z$. So if y and z are distinct, the antecedent of the axiom of extension is false. Of course, when we set y to x and z to the singleton set containing x, it turns out that $x = \{x\}$, given the assumptions.

[4]Krifka (1991) argues that this internal structure is justified only when an explicit conjunction is present, and proposes that examples like (3.24) can be handled via a conjunction for discourse entities. If Krifka is right, we can safely adopt a one-level account.

[5]It is not clear to me whether this closure operation applies to collective predicates like *meet*. For example, if LaToya and Michael meet, and Jermaine and Janet meet, it seems quite dubious to me to say *Four people met*. Cf. Footnote 13.

[6]This degree of redundancy between the two types of conjunction might seem suspicious, and if we were to retain both types, it might be grounds for concern. However, I show below that Lasersohn demonstrates how t-conjunction can be eliminated.

[7]Cf. however some suggestive work by Jacobson (1994) which hints that the two argument positions are not comparable.

[8]I am assuming that coordination precedes existential closure. See Chapter 5.

[9]Lasersohn actually treats VPs as functions from events to sets of individuals and not the other way around. I will ignore this difference in the interests of clarity.

[10]Some, like Bennett (1974) and Hoeksema (1983), believed that these mixed predicates are lexically ambiguous between collective and distributive uses. However, later researchers, such as Lasersohn (1995), have concluded that these mixed predicates have a single lexical denotation containing atoms, groups present by virtue of summativity, and groups present by virtue of collective action. This does not rule out enforcing a distributive-like reading, using something like the D operator of Roberts (1987).

[11]Actually, counting the object wide scope reading, there are four, but this last reading is not relevant to this discussion.

[12]As we will see in Chapter 7 below, summativity is very closely related to the notion of *cumulativity* for sets of individuals, as we find in Krifka (1992).

[13] As usual, the exact account is somewhat more complex than this. Among other things, summativity may apply to some denotations only partially, or asymmetrically. Lasersohn (1995) applies summativity in such a fine-grained manner, on a word-by-word basis. It is also not clear whether summativity applies to collective predicates like *meet*. For example, *the boys and the girls met* can be easily understood as referring to two meetings, but even with heavy intonation, *Michael and LaToya, and Janet and Jermaine, met* refers to two meetings for me only with a great deal of difficulty, although I seem to be in the minority on this judgment.

Chapter 4

Davidsonian Semantics

At this point, I've established the background which shapes this study. I have motivated the presence of events in sentence semantics and demonstrated how they are intimately connected with issues of plurality, distributivity and coordination. I have endorsed accounts of all these phenomena which relate appropriately to events. In this chapter, I will discuss the history of Davidsonian accounts and propose my own account in the framework of Categorial Grammar.

4.1 Background

The history of events in modern formal semantics goes back at least to Davidson (1967). Since then, many people have appealed to events to account for phenomena from the meanings of perception predicates (Higginbotham, 1983) to parallels between nominal and temporal anaphora (Partee, 1984) to problems in modification and quantification, as we saw in Chapter 2.

However, there are few explicit accounts of event-based semantics. In many circumstances, far too little attention is paid to the implications for the rest of the grammar of adding a Davidsonian argument. Among those who have studied the matter relatively carefully in a Davidsonian setting are Krifka (1989; 1990b; 1992), Carpenter (1989), Lasersohn (1995) and Landman (1993). The last two in particular feature detailed descriptions of the syntax/semantics interface for an event-based grammar.

Closely related to these efforts is the work in situation semantics, most particularly the type of situation semantics found in Kratzer (1989).

As we've seen, the partiality of situations means that they have a lot of the locality properties one would want out of a theory of events. Portner (1992), for instance, develops a very detailed dynamic Davidsonian semantics in which he adopts Kratzer-type situations as his Davidsonian elements. We will return to Portner's account in Chapter 5.

4.2 The syntax/semantics interface

Those who have developed Davidsonian accounts of the syntax/semantics interface have by and large adopted one of two syntactic frameworks. One strategy is a GB-like account featuring a level of surface structure (defined by a phrase structure grammar) along with a level of logical form, at which scope relations are determined; this strategy is the choice of Lasersohn and Portner. The other strategy is a Categorial Grammar approach, in which argument structure determines syntactic combination and surface structure is directly interpreted; this is the choice of Carpenter and Krifka.

For a number of reasons, I will follow the latter strategy. First, I find the evidence for a level of logical form far from conclusive, and I believe the implications of a Davidsonian strategy can be more directly confronted without an intermediate level between surface syntax and meaning. Second, the mismatch between syntactic and semantic valence which arises in event-based categorial accounts is far more severe than in phrase structure accounts, and serves as a "starker" setting for investigating the issues. Third, and completely independent of the considerations of events, I find the insights of a lexically-based categorial account more convincing than those of a phrase structure account in a wide range of areas, particularly a number of complex subcases of coordination. I will begin my investigation by describing the classical categorial account, and then augment it with events.

4.2.1 Basics

Categorial Grammar (CG) has its roots in philosophical logic, with applications to syntactic analysis which predate most of modern generative grammar (see Bar-Hillel (1953) and Lambek (1958; 1961), for instance). My formal description of the classical theory of CG which follows may differ in presentation from other descriptions, but it is identical in content, as far as I know.

CG differs from normal phrase-structure grammar in two related ways: first, it countenances a potentially infinite set of syntactic categories, and second, it wears its combinatoric possibilities "on its sleeve", so to speak. CG manifests both these properties in its recursive definition of categories. These categories are defined as follows:

(4.1a) NP, S, CN, ... are categories.
(4.1b) If A is a category and B is a category, then $(\mathrm{A})/_{\mathrm{R}}(\mathrm{B})$ and $(\mathrm{A})/_{\mathrm{L}}(\mathrm{B})$ are categories.
(4.1c) Nothing else is a category.

When the components of a category are simple categories like NP, S, etc., the parentheses may be omitted. Each linguistic constituent is a triple of a string, a category, and a meaning. In my discussion, I will assume variables $\sigma, \sigma_1, \sigma_2, \ldots$ over strings and a function **concat** from pairs of strings into their concatenation; however, in this thesis the strings will not play a significant role. I will also assume variables $m, m_1, m_2, \ldots$ over meanings.

In CG, each syntactic category is assigned some range of semantic types. In the strictest version of CG (such as the syntax/semantics map proposed in Montague (1973)), each syntactic category is assigned a single type; I will assume this strict version here.[1] In an extensional grammar which associates categories with their lowest possible type, the function TYP from syntactic categories to semantic types might be defined as follows. The type of NPs is e, the type of individuals. The type of Ss is t, the type of truth values. The type of CNs is $\langle e, t\rangle$, the type of functions from individuals to truth values. All other types are recursively defined in the same fashion as the syntactic categories are:

(4.2a) $TYP(\mathrm{NP}) = e$
(4.2b) $TYP(\mathrm{V}) = t$
(4.2c) $TYP(\mathrm{CN}) = \langle e, t\rangle$
(4.2d) $\forall \mathrm{A} \forall \mathrm{B}(TYP(\mathrm{A}/_{\mathrm{L}}\mathrm{B}) = TYP(\mathrm{A}/_{\mathrm{R}}\mathrm{B}) = \langle TYP(\mathrm{B}), TYP(\mathrm{A})\rangle)$[2]

So the first manifestation of the tight syntax/semantics map in CG is the strict, productive correspondence between syntactic categories and semantic types.

The second manifestation of this tight coupling is the strict correspondence between syntactic and semantic rules of combination. In

Montague's PTQ, these correspondences were stated as explicit pairings; current CG, on the other hand, might implement this correspondence through operations on constituents. Complex categories in CG are "instructions" for constituent combination, as illustrated by the rules of Function Application (FA):

(4.3) $\mathrm{FA}(\langle \sigma_1, \mathrm{A}/_{\mathrm{R}}\mathrm{B}, m_{1,TYP(\mathrm{A}/_{\mathrm{R}}\mathrm{B})}\rangle, \langle \sigma_2, \mathrm{B}, m_{2,TYP(\mathrm{B})}\rangle) = \langle \mathbf{concat}(\sigma_1)(\sigma_2), \mathrm{A}, m_1(m_2)\rangle$

(4.4) $\mathrm{FA}(\langle \sigma_2, \mathrm{A}/_{\mathrm{L}}\mathrm{B}, m_{2,TYP(\mathrm{A}/_{\mathrm{L}}\mathrm{B})}\rangle, \langle \sigma_1, \mathrm{B}, m_{1,TYP(\mathrm{B})}\rangle) = \langle \mathbf{concat}(\sigma_1)(\sigma_2), \mathrm{A}, m_2(m_1)\rangle$[3]

So (4.3), for instance, permits a rightward-looking category to combine with a constituent which is ordered to its right. Thus the behavior of constituents under FA in the three dimensions can be packaged together, guaranteeing the tight correspondence between syntactic and semantic combination.[4]

In its most straightforward application, this transparency of syntactic combination in CG is used to describe argument structure. So what we think of as an intransitive verb in English is an S/$_{\mathrm{L}}$NP, that is, a category which forms an S via an NP on its left; a transitive verb is an (S/$_{\mathrm{L}}$NP)/$_{\mathrm{R}}$NP.

(4.5)
$$\begin{array}{ccc} \text{The man} & \text{halted} & \text{the bus} \\ \hline \text{NP} & (\text{S}/_{\text{L}}\text{NP})/_{\text{R}}\text{NP} & \text{NP} \\ \cline{2-3} & \multicolumn{2}{c}{\textbf{FA: } \text{S}/_{\text{L}}\text{NP}} \\ \hline \multicolumn{3}{c}{\textbf{FA: S}} \end{array}$$

As required, the denotation of *halt* is a set of pairs of individuals, of type $\langle e, \langle e, t\rangle\rangle$:

(4.6a) $[\![\text{halt}]\!] = \{\langle x_1, y_1\rangle, \ldots\}$
(4.6b) $[\![\text{halt}]\!](y_1) = \{x_1, \ldots\}$
(4.6c) $[\![\text{halt}]\!](y_1)(x_1) = 1$

In other words, in traditional CG, syntactic and semantic functors share a common valence and argument order. This correspondence is part of the tight syntax/semantics map. When we look at neo-Davidsonian compositional alternatives to the classical account, we will see that it is this correspondence between syntactic and semantic valence and argument order which must be compromised.

4.2.2 Complex operations, coordination and quantification

What I have described so far is the simplest sort of applicative Categorial Grammar, whose only rule of combination is Function Application. The version of Categorial Grammar I will assume below also makes freely available crosslinguistically at least two more rules: Function Composition and Type Raising. Categorial Grammars with these properties are discussed by Dowty (1988) and Jacobson (1992). Function Composition (FC) allows the absorption of a peripheral argument to be "postponed". Intuitively, the complex category "pretends" that its argument is complete, and assumes the unsaturated argument of its argument:

(4.7) $\mathrm{FC}(\langle \sigma_1, \mathrm{A/_RB}, m_{1,TYP(\mathrm{A/_RB})}\rangle, \langle \sigma_2, \mathrm{B/_RC}, m_{2,TYP(\mathrm{B/_RC})}\rangle) =$
$\langle \mathbf{concat}(\sigma_1)(\sigma_2), \mathrm{A/_RC}, \lambda m_{TYP(\mathrm{C})}[m_1(m_2(m))]\rangle$

(4.8) $\mathrm{FC}(\langle \sigma_2, \mathrm{A/_LB}, m_{2,TYP(\mathrm{A/_LB})}\rangle, \langle \sigma_1, \mathrm{B/_LC}, m_{1,TYP(\mathrm{B/_LC})}\rangle) =$
$\langle \mathbf{concat}(\sigma_1)(\sigma_2), \mathrm{A/_LC}, \lambda m_{TYP(\mathrm{C})}[m_2(m_1(m))]\rangle$

Type Raising (TR) turns any potential argument category into a function. Intuitively, TR reverses the direction of Function Application between a category A and any potential functor B/A:

(4.9) $\mathrm{TR}(\langle \sigma, \mathrm{A}, m_{1,TYP(\mathrm{A})}\rangle) =$
$\langle \sigma, \mathrm{B/_L(B/_RA)}, \lambda m_{2,TYP(\mathrm{B/_RA})}[m_2(m_1)]\rangle$

(4.10) $\mathrm{TR}(\langle \sigma, \mathrm{A}, m_{1,TYP(\mathrm{A})}\rangle) =$
$\langle \sigma, \mathrm{B/_R(B/_LA)}, \lambda m_{2,TYP(\mathrm{B/_LA})}[m_2(m_1)]\rangle$

It should be fairly obvious that FC and TR vastly increase the possibilities for category combination; FC defines a new way for categories to combine, while TR can feed FC by creating different sorts of complex categories. For example, FC and TR together enable the following derivation of transitive sentences alongside the derivation in (4.5) which involves only Function Application:[5]

(4.11)

The man	halted	the bus
NP	$(\mathrm{S/_LNP})/_\mathrm{R}\mathrm{NP}$	NP
TR: $\mathrm{S/_R(S/_LNP)}$		
FC: $\mathrm{S/_RNP}$		
FA: S		

So what are these rules good for?

4.2.2.1 Coordination and quantification

Let's start with the interaction of Type Raising with coordination and quantification. Since generalized quantifiers are functions from sets of individuals to truth values, their syntactic category is a functor from VP denotations to S denotations:

(4.12) $\langle$"every boy", $\mathrm{S/_R(S/_LNP)}$, $every'(boy')\rangle$

Just as generalized conjunction conjoins objects of identical semantic type, the syntactic category corresponding to coordinating elements takes two identical categories as arguments:

(4.13) $\langle$"and", $(\alpha/_\mathrm{L}\alpha)/_\mathrm{R}\alpha, \sqcap\rangle$

With these tools, we can show that the syntactico-semantic analog of Partee's type raising operation from (3.17), namely the TR operation in (4.9) and (4.10) above, allows us to analyze conjunctions of proper nouns and generalized quantifiers simultaneously in syntax and semantics. Here we produce the derivation of the previous (3.14):

(4.14) TR($\langle$"LaToya", NP, $l\rangle$) = $\langle$"LaToya", $\mathrm{S/_R(S/_LNP)}$, $\lambda P[P(l)]\rangle$

(3.14) LaToya and every boy ran.

(4.15)

$$
\begin{array}{ccccc}
\text{LaToya} & \text{and} & \text{every} & \text{boy} & \text{ran} \\
\hline
\mathrm{NP}, & (\alpha/_\mathrm{L}\alpha)/_\mathrm{R}\alpha, & \mathrm{(S/_R(S/_LNP))/_RCN}, & \mathrm{CN}, & \mathrm{S/_LNP}, \\
l & \sqcap & every' & boy' & run'
\end{array}
$$

$$\frac{\text{every} \quad \text{boy}}{\textbf{FA: } \mathrm{S/_R(S/_LNP)},\ every'(boy')}$$

$$\frac{\text{LaToya}}{\textbf{TR: } \mathrm{S/_R(S/_LNP)},\ \lambda P[P(l)]}$$

$$\frac{\text{and} \quad \text{every boy}}{\textbf{FA: } \mathrm{(S/_R(S/_LNP))/_L(S/_R(S/_LNP))},\ \lambda\mathcal{D}[\mathcal{D} \sqcap every'(boy')]}$$

$$\frac{\text{LaToya} \quad \text{and every boy}}{\textbf{FA: } \mathrm{S/_R(S/_LNP)},\ \lambda P[P(l)] \sqcap every'(boy')}$$

$$\frac{\text{LaToya and every boy} \quad \text{ran}}{\textbf{FA: } \mathrm{S},\ [\lambda P[P(l)] \sqcap every'(boy')](run')}$$

The final interpretation expands and reduces as follows:

(4.16) $[\lambda P[P(l)] \sqcap every'(boy')](run') =$
$\lambda P[P(l) \sqcap every'(boy')(P)](run') =$
$run'(l) \wedge every'(boy')(run')$

4.2.2.2 Nonconstituent coordination

These combinatoric rules are also relevant to unusual coordinate structures. That is, with these rules we can build strange constituents, and these constituents can be coordinated. Consider coordinations like those in (4.17):

(4.17a) LaToya halted, and Jermaine boarded, the bus.
(4.17b) Jermaine met LaToya yesterday and Michael today.

(4.17a) is an instance of Right Node Raising (RNR); (4.17b) is an instance of nonconstituent coordination (NCC). Because these coordinations were thought not to involve constituents, they were held to be outside the scope of the generalization that only constituents bearing identical categories can be coordinated. However, Gazdar (1981), as part of the foundation of Generalized Phrase Structure Grammar, demonstrated that RNR, and cases of across-the-board (ATB) extraction in coordinate constructions, could be brought under the scope of this generalization by encoding the category of the extracted constituents in the including category itself.[6] Because complex categories in CG encode the syntactic category of unsaturated arguments, CG can use the operations of FC and TR to produce an analogous straightforward account (cf. Dowty (1988), for instance):

(4.18)

$$
\begin{array}{cc}
\text{LaToya} & \text{halted} \\
\hline
\text{NP}, & (\text{S}/_{\text{L}}\text{NP})/_{\text{R}}\text{NP}, \\
l & halt' \\
\hline
\textbf{TR: } \text{S}/_{\text{R}}(\text{S}/_{\text{L}}\text{NP}), & \\
\lambda P[P(l)] & \\
\hline
\multicolumn{2}{c}{\textbf{FC: } \text{S}/_{\text{R}}\text{NP},} \\
\multicolumn{2}{c}{\lambda x[\lambda P[P(l)](halt'(x))]}
\end{array}
$$

(4.19)

$$\dfrac{\dfrac{\dfrac{\text{LaToya halted}}{\text{S}/_{\text{R}}\text{NP}, \\ \lambda x[\lambda P[P(l)](halt'(x))]} \qquad \dfrac{\dfrac{\text{and}}{(\alpha/_{\text{L}}\alpha)/_{\text{R}}\alpha, \\ \sqcap} \quad \dfrac{\text{Jermaine boarded}}{\text{S}/_{\text{R}}\text{NP}, \\ \lambda x[\lambda P[P(j)](board'(x))]}}{\textbf{FA: } (\text{S}/_{\text{R}}\text{NP})/_{\text{L}}(\text{S}/_{\text{R}}\text{NP}), \\ \lambda P[P \sqcap \lambda x[\lambda P[P(j)](board'(x))]]}}{\textbf{FA: } \text{S}/_{\text{R}}\text{NP}, \\ [\lambda x[\lambda P[P(l)](halt'(x))] \sqcap \lambda x[\lambda P[P(j)](board'(x))]]} \qquad \dfrac{\text{the bus}}{\text{NP}, \\ b_1}}{\textbf{FA: } \text{S}, [\lambda x[\lambda P[P(l)](halt'(x))] \sqcap \lambda x[\lambda P[P(j)](board'(x))]](b_1)}$$

The final interpretation of (4.19) reduces as follows:

(4.20)
$$\begin{aligned}
&[\lambda x[\lambda P[P(l)](halt'(x))] \sqcap \lambda x[\lambda P[P(j)](board'(x))]](b_1) = \\
&\lambda x[\lambda P[P(l)](halt'(x)) \sqcap \lambda P[P(j)](board'(x))](b_1) = \\
&\lambda P[P(l)](halt'(b_1)) \sqcap \lambda P[P(j)](board'(b_1)) = \\
&halt'(b_1)(l) \sqcap board'(b_1)(j) = \\
&halt'(b_1)(l) \wedge board'(b_1)(j)
\end{aligned}$$

That is, *LaToya halted, and Jermaine boarded, the bus* is true just in case LaToya halted the bus and Jermaine boarded the bus.

Now, it is not simply that CG can do what GPSG can do. More recalcitrant cases of NCC such as the one in (4.17b) are beyond the scope of GPSG, while CG can describe these cases straightforwardly (cf. Dowty (1988)):[7]

(4.21)
$$\dfrac{\dfrac{\dfrac{\text{LaToya}}{\text{NP}}}{\textbf{TR: } \text{VP}/_{\text{L}}(\text{VP}/_{\text{R}}\text{NP})} \qquad \dfrac{\text{yesterday}}{\text{VP}/_{\text{L}}\text{VP}}}{\textbf{FC: } \text{VP}/_{\text{L}}(\text{VP}/_{\text{R}}\text{NP})}$$

(4.22)
$$\dfrac{\dfrac{\text{LaToya yesterday}}{\text{VP}/_{\text{L}}(\text{VP}/_{\text{R}}\text{NP})} \qquad \dfrac{\dfrac{\text{and}}{(\alpha/_{\text{L}}\alpha)/_{\text{R}}\alpha} \quad \dfrac{\text{Michael today}}{\text{VP}/_{\text{L}}(\text{VP}/_{\text{R}}\text{NP})}}{\textbf{FA: } (\text{VP}/_{\text{L}}(\text{VP}/_{\text{R}}\text{NP}))/_{\text{L}}(\text{VP}/_{\text{L}}(\text{VP}/_{\text{R}}\text{NP}))}}{\textbf{FA: } \text{VP}/_{\text{L}}(\text{VP}/_{\text{R}}\text{NP})}$$

(4.23)

$$\dfrac{\dfrac{\text{Jermaine}}{\text{NP}} \quad \dfrac{\dfrac{\text{met}}{\text{VP}/_{\text{R}}\text{NP}} \quad \dfrac{\text{LaToya yesterday and Michael today}}{\text{VP}/_{\text{L}}(\text{VP}/_{\text{R}}\text{NP})}}{\textbf{FA: VP}}}{\textbf{FA: S}}$$

4.2.3 *Argument Raising*

There is one other generally available operation I want to introduce. How do generalized quantifiers occupy nonsubject positions? Given a transitive verb like *love*, of type $\langle e, \langle e, t\rangle\rangle$, and a generalized quantifier like *every man*, of type $\langle\langle e, t\rangle, t\rangle$, it's not immediately clear what sequence of operations would allow us to derive the object narrow-scope reading of the VP *love every man*, since neither the verb nor generalized quantifier is of the appropriate type to serve as the argument of the other. We could function compose the subject with the transitive verb, as we do in (4.11), but the resulting interpretation yields an object wide-scope reading:

(4.24)

$$\dfrac{\dfrac{\dfrac{\text{A woman}}{\text{S}/_{\text{R}}(\text{S}/_{\text{L}}\text{NP}),\ a'(woman')} \quad \dfrac{\text{loves}}{(\text{S}/_{\text{L}}\text{NP})/_{\text{R}}\text{NP},\ love'}}{\textbf{FC: } \text{S}/_{\text{R}}\text{NP},\ \lambda x[a'(man')(love'(x))]} \quad \dfrac{\text{every man}}{\text{S}/_{\text{L}}(\text{S}/_{\text{R}}\text{NP}),\ every'(man')}}{\textbf{FA: } \text{S},\ every'(man')(\lambda x[a'(man')(love'(x))])}$$

There is also a small but nagging issue with needing to postulate an ambiguity in the direction of the syntactic category of generalized quantifiers, one looking right and another looking left.

One solution to this problem is an operation of Argument Raising (Hendriks, 1993; Jacobson, 1992; Partee and Rooth, 1983). I will focus on argument raising the most oblique argument.[8] While Partee and Hendriks do not connect the semantic type-shifting operation with a corresponding syntactic operation, I will follow Jacobson in making the connection. Furthermore, I will define Argument Raising for only one slash direction of the raised argument category; the choice is irrelevant, since the argument category is not syntactically functional. This semantic type-shifting rule is a simplification of that found in Hendriks (1993). Here $\vec{b}$ is a sequence of types:

(4.25) For every meaning m of type $\langle a, \langle \vec{b}, c\rangle\rangle$ and every category C of type c, AR($\langle \sigma, \mathrm{B}/_{\mathrm{R}}\mathrm{A}, m\rangle$, C) =
$\langle \sigma, \mathrm{B}/_{\mathrm{R}}(\mathrm{C}/_{\mathrm{R}}(\mathrm{C}/_{\mathrm{L}}\mathrm{A})), \lambda x_{\langle\langle a,c\rangle,c\rangle}\lambda \vec{y}_{\vec{b}}[x(\lambda z_a[m(z)(\vec{y})])]\rangle$

(4.26) For every meaning m of type $\langle a, \langle \vec{b}, c\rangle\rangle$ and every category C of type c, AR($\langle \sigma, \mathrm{B}/_{\mathrm{L}}\mathrm{A}, m\rangle$, C) =
$\langle \sigma, \mathrm{B}/_{\mathrm{L}}(\mathrm{C}/_{\mathrm{R}}(\mathrm{C}/_{\mathrm{L}}\mathrm{A})), \lambda x_{\langle\langle a,c\rangle,c\rangle}\lambda \vec{y}_{\vec{b}}[x(\lambda z_a[m(z)(\vec{y})])]\rangle$

In the classical account, the case we are interested in is the one in which $\mathrm{C}/_{\mathrm{R}}(\mathrm{C}/_{\mathrm{L}}\mathrm{A})$ is $\mathrm{S}/_{\mathrm{R}}(\mathrm{S}/_{\mathrm{L}}\mathrm{NP})$, that is, the case of generalized quantifiers in (nonsubject) argument positions.[9] I will employ variables $\mathcal{D}$ over generalized quantifiers. So let's raise the most oblique argument of *love*:

(4.27) AR($\langle$"love", $(\mathrm{S}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP}, love'\rangle$, S) =
$\langle$"love", $(\mathrm{S}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}(\mathrm{S}/_{\mathrm{R}}(\mathrm{S}/_{\mathrm{L}}\mathrm{NP})), \lambda\mathcal{D}\lambda x[\mathcal{D}(\lambda y[love'(y)(x)])]\rangle$

The derivation of the object narrow-scope analogue of (4.24) is

(4.28)

A woman	loves	every man
$\mathrm{S}/_{\mathrm{R}}(\mathrm{S}/_{\mathrm{L}}\mathrm{NP})$, $a'(woman')$	$(\mathrm{S}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP}$, $love'$	$\mathrm{S}/_{\mathrm{R}}(\mathrm{S}/_{\mathrm{L}}\mathrm{NP})$, $every'(man')$
	AR: $(\mathrm{S}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}(\mathrm{S}/_{\mathrm{R}}(\mathrm{S}/_{\mathrm{L}}\mathrm{NP}))$, $\lambda\mathcal{D}\lambda x[\mathcal{D}(\lambda y[love'(y)(x)])]$	
	FA: $\mathrm{S}/_{\mathrm{L}}\mathrm{NP}$, $\lambda x[every'(man')(\lambda y[love'(y)(x)])]$	
FA: S, $a'(woman')(\lambda x[every'(man')(\lambda y[love'(y)(x)])])$		

In this way, it is possible to produce a reading for any most oblique argument position where generalized quantifiers do not take scope over any higher arguments. The oblique wide-scope reading, as before, can be generated via Function Composition, as illustrated previously in (4.24).[10]

In this brief review, I cannot do justice to the enormous range of work done in CG. For example, in addition to concatenation, some versions of CG admit a wrap operation (Dowty, 1988; Jacobson, 1992), which relies on a more articulated structure for strings. There is also a wide range of work on restricting the power of CGs by appealing to the strict mathematical properties of the functional operations that CG relies on. For my purposes, the operations of FC and TR conspire to produce insightful and straightforward syntactic accounts of phenomena which are unanalyzable in other frameworks. In addition, these operations define correspondences between the syntactic and semantic dimensions which are transparent and straightforward.

4.3 Event Categorial Grammar

In the previous section, we've seen a number of desirable properties of CG: its tight type correspondence between syntax and semantics, its combinatorial flexibility, its accounts of quantification and coordination. In this section, I will reconstruct these ideas in a Davidsonian semantics. The framework I will outline is in many ways an extensional version of the event-based CG of Carpenter (1989). In particular, I follow Carpenter's type assignments for basic categories (with one notable exception), and I assume (a variant of) his interpretation of *every*, as we will see in a moment. The discussion of the interactions of Davidsonian constituents with Function Composition, generalized conjunction and Type Raising, on the other hand, is mine.

The first adjustment we must make is to the initial type assignments. I intend to take seriously the fact that Davidsonian analyses require some sort of existential closure over event sets, and as a result I will part with Carpenter and refrain from assigning the type of sets of events to the S category. Instead, I will follow Krifka (1990b) in introducing the category V to correspond to sets of events, and postpone the discussion of existential closure *per se* to Chapter 5. I will use ϵ as the type of events:

(4.29a) $TYP(\mathrm{NP}) = e$
(4.29b) $TYP(\mathrm{V}) = \langle \epsilon, t \rangle$
(4.29c) $TYP(\mathrm{CN}) = \langle e, t \rangle$
(4.29d) $\forall \mathrm{A} \forall \mathrm{B}(TYP(\mathrm{A}/_{\mathrm{L}}\mathrm{B}) = TYP(\mathrm{A}/_{\mathrm{R}}\mathrm{B}) = \langle TYP(\mathrm{B}), TYP(\mathrm{A}) \rangle)$

This change leads inevitably to the other changes in the system. For instance, the syntactic derivation in (4.5) remains the same, but in this case *halt* is a relation among two individuals and an event:

(4.30a) $[\![\text{halt}]\!] = \{\langle e_1, x_1, y_1\rangle, \ldots\}$
(4.30b) $[\![\text{halt}]\!](y_1) = \{\langle e_1, x_1\rangle, \ldots\}$
(4.30c) $[\![\text{halt}]\!](y_1)(x_1) = \{e_1, \ldots\}$

The first surprise comes when we consider generalized quantifiers. They're still functions from VP denotations to V denotations, but their type, of course, is now $\langle\langle e, \langle \epsilon, t\rangle\rangle, \langle \epsilon, t\rangle\rangle$ rather than $\langle\langle e, t\rangle, t\rangle$. That is, determiners no longer denote relations between sets of individuals. What would such a determiner actually mean now? Assuming E, F as variables over Davidsonian VP denotations, here are candidate meanings for *a(n)* and *every*:

(4.31) $[\![\text{a}]\!] = \lambda P \lambda E \lambda e[\exists x(P(x) \wedge E(x)(e))]$

(4.32) $[\![\text{every}]\!] = \lambda P \lambda E \lambda e[\forall x(P(x) \rightarrow \exists e'(e' \leq e \wedge E(x)(e')))]$

The meaning I've chosen for *every* here is not universally accepted. It is quite similar to that chosen by Krifka (1990b) and Carpenter (1989), but somewhat different from, and more complex than, the one chosen by Lasersohn (1995), which would look like this in my terms:

(4.33) $[\![\text{every}]\!] = \lambda P \lambda E \lambda e[\forall x(P(x) \rightarrow E(x)(e))]$

Lasersohn's version is exactly parallel to the meaning of *a* in (4.31), and clearly less complex than my proposal in (4.32). The reason for this difference is that I assume that event arguments are filled by what I'll call *minimal* events, while Lasersohn assumes that they need not be. That is, $E(x)(e)$ for Lasersohn means that x performs E somewhere in e (and lots more can be going on in e besides that), while for me it means that e amounts to x performing E and nothing more. This difference, like the issue of existential closure, has detailed implications for Davidsonian semantics, and I will postpone a detailed discussion to Section 5.3. In the remainder of this discussion, I will assume that events are minimal.[11]

If we want to coordinate these Davidsonian generalized quantifiers with proper nouns, we still have to type raise over the type of V. In the current framework, such an operation looks like this:

(4.34) TR(⟨"LaToya", NP, *l*⟩) =
⟨"LaToya", V/$_{\text{R}}$(V/$_{\text{L}}$NP), $\lambda E \lambda e[E(l)(e)]$⟩

And perhaps the largest change is that the meaning of *and* becomes the e-conjunction of Link, Hoeksema, Krifka, and Lasersohn discussed in Section 3.6:

(4.35) $\langle$"and", $(\alpha/_{\mathrm{L}}\alpha)/_{\mathrm{R}}\alpha$, $\&$ $\rangle$

So the derivation of (3.14) now evolves as follows:

(4.36)

$$\begin{array}{cccc}
\text{LaToya} & \text{and} & \text{every boy} & \text{ran} \\
\hline
\text{NP}, & (\alpha/_{\mathrm{L}}\alpha)/_{\mathrm{R}}\alpha, & \text{V}/_{\mathrm{R}}(\text{V}/_{\mathrm{L}}\text{NP}), & \text{V}/_{\mathrm{L}}\text{NP}, \\
l & \& & every'(boy') & run'
\end{array}$$

$$\frac{}{\textbf{TR: } \text{V}/_{\mathrm{R}}(\text{V}/_{\mathrm{L}}\text{NP}),\ \lambda P\lambda e[P(l)(e)]}$$

$$\frac{}{\textbf{FA: } (\text{V}/_{\mathrm{R}}(\text{V}/_{\mathrm{L}}\text{NP}))/_{\mathrm{L}}(\text{V}/_{\mathrm{R}}(\text{V}/_{\mathrm{L}}\text{NP})),\ \lambda\mathcal{D}[\mathcal{D}\ \&\ every'(boy')]}$$

$$\frac{}{\textbf{FA: } \text{V}/_{\mathrm{R}}(\text{V}/_{\mathrm{L}}\text{NP}),\ \lambda E\lambda e[E(l)(e)]\ \&\ every'(boy')}$$

$$\frac{}{\textbf{FA: } \text{V},\ [\lambda E\lambda e[E(l)(e)]\ \&\ every'(boy')](run')}$$

The new interpretation of (3.14) expands and reduces as follows. Remember that e-conjunction behaves like t-conjunction in all argument positions which do not involve individuals or events:

(4.37) $[\lambda E\lambda e[E(l)(e)]\ \&\ every'(boy')](run') =$
$[\lambda E\lambda e[E(l)(e)]\ \&$
$\quad \lambda E\lambda e[\forall x(boy'(x) \rightarrow \exists e'(e' \leq e \wedge E(x)(e')))]](run') =$
$\lambda E[\lambda e[E(l)(e)]\ \&$
$\quad \lambda e[\forall x(boy'(x) \rightarrow \exists e'(e' \leq e \wedge E(x)(e')))]](run') =$
$\lambda e[run'(l)(e)]\ \&\ \lambda e[\forall x(boy'(x) \rightarrow \exists e'(e' \leq e \wedge run'(x)(e')))] =$
$\lambda e[\exists e_1\exists e_2(e = e_1 + e_2 \wedge run'(l)(e_1) \wedge$
$\quad \forall x(boy'(x) \rightarrow \exists e'(e' \leq e_2 \wedge run'(x)(e'))))]$

In other words, *LaToya and every boy run* is that set of events each of which is the sum of two parts, one of which is a running by LaToya and the other of which contains a running by every boy.[12]

By now, we ought to have made enough adjustments that a parallel derivation of the RNR case in (4.19) ought to be possible:

(4.38)

$$\cfrac{\cfrac{\text{LaToya}}{\text{NP},\ l}}{\textbf{TR: } \text{V}/_{\text{R}}(\text{V}/_{\text{L}}\text{NP}),\ \lambda E\lambda e[E(l)(e)]} \qquad \cfrac{\text{halted}}{(\text{V}/_{\text{L}}\text{NP})/_{\text{R}}\text{NP},\ halt'}$$

$$\textbf{FC: } \text{V}/_{\text{R}}\text{NP},\ \lambda x[\lambda E\lambda e[E(l)(e)](halt'(x))]$$

(4.39)

$$\cfrac{\text{LaToya halted}}{\text{V}/_{\text{R}}\text{NP},\ \lambda x[\lambda E\lambda e[E(l)(e)](halt'(x))]} \qquad \cfrac{\text{and}}{(\alpha/_{\text{L}}\alpha)/_{\text{R}}\alpha,\ \&} \qquad \cfrac{\text{Jermaine boarded}}{\text{V}/_{\text{R}}\text{NP},\ \lambda x[\lambda E\lambda e[E(j)(e)](board'(x))]}$$

$$\textbf{FA: } (\text{V}/_{\text{R}}\text{NP})/_{\text{L}}(\text{V}/_{\text{R}}\text{NP}),\ \lambda F[F\ \&\ \lambda x[\lambda E\lambda e[E(j)(e)](board'(x))]]$$

$$\textbf{FA: } \text{V}/_{\text{R}}\text{NP},\ [\lambda x[\lambda E\lambda e[E(l)(e)](halt'(x))]\ \&\ \lambda x[\lambda E\lambda e[E(j)(e)](board'(x))]]$$

(4.40)

$$\cfrac{\text{LaToya halted and Jermaine boarded}}{\text{V}/_{\text{R}}\text{NP},\ [\lambda x[\lambda E\lambda e[E(l)(e)](halt'(x))]\ \&\ \lambda x[\lambda E\lambda e[E(j)(e)](board'(x))]]} \qquad \cfrac{\text{the bus}}{\text{NP},\ b_1}$$

$$\textbf{FA: } \text{V},\ [\lambda x[\lambda E\lambda e[E(l)(e)](halt'(x))]\ \&\ \lambda x[\lambda E\lambda e[E(j)(e)](board'(x))]](b_1)$$

The final interpretation of this example reduces as follows. Once again, remember that e-conjunction behaves like t-conjunction in all argument positions which do not involve individuals or events:

(4.41)
$$\begin{aligned}
&[\lambda x[\lambda E\lambda e[E(l)(e)](halt'(x))]\ \&\\
&\qquad \lambda x[\lambda E\lambda e[E(j)(e)](board'(x))]](b_1) =\\
&\lambda x[\lambda E\lambda e[E(l)(e)](halt'(x))\ \&\\
&\qquad \lambda E\lambda e[E(j)(e)](board'(x))](b_1) =\\
&\lambda E\lambda e[E(l)(e)](halt'(b_1))\ \&\ \lambda E\lambda e[E(j)(e)](board'(b_1)) =\\
&\lambda e[halt'(b_1)(l)(e)]\ \&\ \lambda e[board'(b_1)(j)(e)] =\\
&\lambda e[\exists e'\exists e''(e = e' + e'' \wedge halt'(b_1)(l)(e') \wedge board'(b_1)(j)(e''))]
\end{aligned}$$

That is, *LaToya halted, and Jermaine boarded, the bus* is that set of events which consist of an event of LaToya halting the bus and an event of Jermaine boarding the bus.

Finally, we turn to Argument Raising. Our ultimate result category is V for the moment, and we will thus raise the argument over V instead of S, and thus over $\langle \epsilon, t \rangle$ instead of t. Therefore, raising the object of *love* now looks like this. Here, $\mathcal{D}$ ranges over Davidsonian generalized quantifiers:

(4.42) AR(⟨"love", $(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP}$, $love'$⟩, V) =
⟨"love", $(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP}))$,
$\lambda\mathcal{D}\lambda x[\mathcal{D}(\lambda y\lambda e[love'(y)(x)(e)])]$⟩

The derivation of *A woman loves every man* now looks like this:

(4.43)

A woman	loves	every man
$\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})$, $a'(woman')$	$(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP}$, $love'$	$\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})$, $every'(man')$
	AR: $(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP}))$, $\lambda\mathcal{D}\lambda x[\mathcal{D}(\lambda y\lambda e[love'(y)(x)(e)])]$	
	FA: $\mathrm{V}/_{\mathrm{L}}\mathrm{NP}$, $\lambda x[every'(man')(\lambda y\lambda e[love'(y)(x)(e)])]$	
FA: V, $a'(woman')(\lambda x[every'(man')(\lambda y\lambda e[love'(y)(x)(e)])])$		

To see that this reduces appropriately, we employ the definitions of *a* and *every* in (4.31) and (4.32) above:

(4.31) $[\![\mathrm{a}]\!] = \lambda P\lambda E\lambda e[\exists x(P(x) \wedge E(x)(e))]$

(4.32) $[\![\mathrm{every}]\!] = \lambda P\lambda E\lambda e[\forall x(P(x) \rightarrow \exists e'(e' \leq e \wedge E(x)(e')))]$

(4.44) $a'(woman')(\lambda x[every'(man')(\lambda y\lambda e[love'(y)(x)(e)])]) =$
$a'(woman')(\lambda x[\lambda P\lambda E\lambda e[\forall x(P(x) \rightarrow \exists e'(e' \leq e \wedge E(x)(e')))]$
$(man')(\lambda y\lambda e[love'(y)(x)(e)])]) =$
$a'(woman')(\lambda x\lambda e[\forall y(man'(y) \rightarrow$
$\exists e'(e' \leq e \wedge love(y)(x)(e')))]) =$
$\lambda P\lambda E\lambda e[\exists x(P(x) \wedge E(x)(e))](woman')(\lambda x\lambda e[\forall y(man'(y) \rightarrow$
$\exists e'(e' \leq e \wedge love(y)(x)(e')))]) =$
$\lambda e[\exists x(woman'(x) \wedge \forall y(man'(y) \rightarrow$
$\exists e'(e' \leq e \wedge love(y)(x)(e'))))]$

That is, *A woman loves every man*, on its object narrow-scope reading, is that set of events such that for each event there is some woman who is loved by each man in a subevent of of that event.

I have demonstrated in this section that the desirable properties of CG can be maintained in a Davidsonian context. Coordination and quantification must be changed in ways that compromise their truth-conditional properties, but these compromises can be justified in the larger context of event semantics. However, there are a number of issues which I have yet to address which bear heavily on the ultimate success of this venture. I have alluded to the two most pressing of these issues, existential closure and the size of events, in the immediately preceding discussion. I turn to these issues in the next chapter.

Notes

[1]I will not concern myself with intensionality at the moment, nor with the flexible types of Partee (1986) or the families of types of Hendriks (1993).

[2]The subscripts L and R indicate left and right concatenation, respectively, following Jacobson (1992).

[3]Typically, the arguments to the FA operation are given in surface linear order. However, these accounts typically omit the string dimension, using the order of constituents as the source of string ordering information. Since the string concatenation information is given explicitly as a grammatical dimension in the present account, I present FA (and FC below) in canonical functor-first order. This formulation has explicit advantages when we turn to alternatives to concatenation, such as wrap, which are not susceptible to inferences based on the prior linear order of constituents. Cf. Jacobson (1992).

[4]And string combination as well.

[5]See Jacobson (1992) and references therein.

[6]Cf. Gazdar and others (1985) for further details.

[7]In this example and elsewhere, I will abbreviate $S/_{L}NP$ as VP when such shorthand does not obscure the discussion.

[8]Hendriks, for instance, makes it clear that this operation can be generalized to any argument position. While this generalization is required for some complex scopal interactions, it will not be necessary in this study.

[9]My definition of Argument Raising will apply trivially to subject position, but this is merely in the interests of generality.

[10]These two mechanisms together address only a subset of the scope possibilities in ditransitives; the remainder require, as far as I can tell, more complex type raising (cf. Hendriks (1993)) or simultaneous raising of multiple arguments. Discussing these cases in any detail is beyond the scope of this thesis.

[11]My definition for *every* in (4.32) does not enforce this condition; I return to this matter in Chapter 5.

[12]Note that there seems to be a dependency between the size of events and the need for e-conjunction. In particular, at first glance it might seem that t-conjunction might suffice here if events are nonminimal, since nonminimal events might be big enough to contain both LaToya's running

and the runnings of each boy. So *LaToya and every boy run* might be that set of events which both contains a running by LaToya and contains a running by each boy; such an interpretation is intersective and thus conforms to the case of t-conjunction. It might seem odd, given this dependency, that Lasersohn (1995) would endorse both e-conjunction and nonminimal events; however, since Lasersohn demonstrates that e-conjunction subsumes t-conjunction, and because e-conjunction can be justified on independent grounds, there is no reason to question his conclusions.

Chapter 5

The Devil in the Davidsonian Details

Nothing that I've said so far about Davidsonian semantics is really controversial. I've shown that changing the relevant "final" type to $\langle\epsilon, t\rangle$ rather than t does not perturb hard-won insights about the behavior of quantification and coordination. I turn now to two issues which, to my mind, have been examined in insufficient detail in event semantics: existential closure and the size of events.

5.1 Existential closure

5.1.1 Setting the stage

What type of object do sentences actually denote? Like Krifka, I have assigned the type of sets of events to the category V; but we have yet to say anything about how to convert elements of this syntactic and semantic type to S and truth values. That is, in the simplest case, it seems that by uttering (5.1a), I intend not (5.1b) but rather (5.1c):

(5.1a) LaToya ran.
(5.1b) $\lambda e[run'(l)(e)]$
(5.1c) $\exists e(run'(l)(e))$

That is, in order to complete the account of events, we must say something about how the set of events is existentially closed. A representative responsible proposal is made by Krifka (1990b). Krifka proposes a type shifter which converts V, of type $\langle\epsilon, t\rangle$, to S, of type t, by virtue of existentially closing the event set:

(5.2) $\langle$"", S/V, $\lambda P[\exists e(P(e))]\rangle$

This is the shifter which transforms (5.1b) into (5.1c).[1]

This solution seems very simple and neat, but the problem is rather more complex than this. For instance, existential closure seems not to be the only type of closure available to us. "Generic" statements about events seem to involve some sort of quantification (sometimes explicit) over events other than existential:

(5.3) Michael (usually) rehearses for three hours.

We seem to require a second closure operator, which introduces a generic operator:

(5.4) $\langle$"", S/V, $\lambda P[\mathrm{G}e(P(e))]\rangle$[2]

Furthermore, event-like constituents occur in a number of other positions as well, and it's not exactly clear what semantic type ought to be assigned to these constituents. I turn to these questions now.

5.1.2 Event arguments

For example, recall the arguments of Vendler (1967) and Bäuerle (1988) from Chapter 2 that some "containers" support events and others support propositions. We saw for NPs, for instance, that while *surprise* tolerates descriptions of things not happening, *occur* does not, suggesting that the argument of *surprise* is a proposition (which can describe any state of affairs, including nonexistent ones), while the argument of *occur* is an event:

(2.33a) The non-arrival of the train surprised me.
(2.33b) *The non-arrival of the train occurred at noon.

In that discussion, we concluded that Ss in argument positions do not denote events, based on their inappropriateness as the subject of *occur*, which selects for events:

(2.34a) The arrival of the train surprised me.
(2.34b) The arrival of the train occurred at noon.
(2.34c) That the train arrived surprised me.
(2.34d) *That the train arrived occurred at noon.

It turns out that this conclusion is somewhat premature. The subordinating element *until* seems to govern events just as *occur* does, but it subcategorizes for S as well as NP:

(5.5a) LaToya sang until Jermaine arrived.
(5.5b) *LaToya sang until Jermaine didn't arrive.
(5.5c) LaToya sang until Jermaine's arrival.
(5.5d) *LaToya sang until Jermaine's non-arrival.

So we've identified argument positions where both S and NP denote event-like objects. But what is the type of these objects? In the case of the NP arguments, the answer is easy: the same as any other NP-type object. Verbs like *last* and *occur* select for events, and NPs which denote or refer to event-like objects denote either elements of $\mathcal{E}$ (the domain of events) or the corresponding generalized quantifier type. Here $last{-}for{-}three{-}hours'$ is a Davidsonian VP denotation, which is a relation between an event (such as a rehearsal) and the eventuality (state, situation) of that event lasting for three hours:

(5.6a) Every rehearsal lasted for three hours.
(5.6b) [[Every rehearsal lasted for three hours]] =

$$\lambda e[\forall e'(rehearsal'(e') \rightarrow \exists e''(e'' \leq e \wedge last{-}for{-}three{-}hours'(e')(e'')))]$$

(5.7) The rehearsal/It lasted for three hours.

What is relevant here is that while NPs corresponding to events are either of type ϵ or $\langle\langle\epsilon, \langle\epsilon, t\rangle\rangle, \langle\epsilon, t\rangle\rangle$, so far the only types we've assigned to sentence-level constituents corresponding to events are $\langle\epsilon, t\rangle$ (for V) and t (for S). In other words, the story we've told about V and S so far means that the analysis of *until NP* differs significantly from the analysis of *until S*. Why would the range of possibilities differ so markedly between the two cases? We will return to this question shortly.

5.1.3 Adverbial quantification

The other important context in which event-like descriptions appear is in cases of adverbial quantification. We saw in Chapter 2 that Rothstein's analysis of *every time* represented the main clause as being within the scope of the adverbial subordinating element:

(2.20) Every time the bell rings, Mary opens the door.

(2.21) $\forall e(ring'(the{-}bell')(e) \rightarrow$
$\exists e'(open'(the{-}door')(m)(e') \wedge M(e') = e))$

In my discussion of these examples, I argued that the analysis of *when*, *whenever*, etc., ought to be parallel, based on their common interactions with the individual/stage distinction, the matching effect and the proportion problem. However, I ignored the fact that in Rothstein's account, the type of (2.20) is t, not $\langle \epsilon, t \rangle$. That is, it does not yet conform to the Davidsonian principles of verbal modification, which are based on a parallel with CN modification. CN modifiers denote functions from sets of individuals to sets of individuals. Rothstein's analysis of quantificational adverbial modification maps sets of individuals into truth values. Is Rothstein's modification, then, a different type of modification?

I don't think so. I will demonstrate that the type of (2.20) and related examples is $\langle \epsilon, t \rangle$, not t. My argument has much in common with Roberts' (1993) argument against the intersective analysis of adverbial modifiers introduced by *when* and *if*. Consider (5.8):

(5.8a) For three months, every time LaToya used the family name, Michael filed two lawsuits.
(5.8b) Last December, every time LaToya gave a concert, Michael filed exactly two lawsuits.
(5.8c) In December, every time LaToya gives a concert, she dedicates it to Santa Claus.

Each of these examples supports the event-set view of adverbial quantification in a different way. For instance, (5.8a) shows that these adverbials transform the aspectual type of the main clause. Since *for three months* modifies unbounded events like processes and states rather than bounded events like accomplishments and achievements (cf. Dowty (1979)), it is incompatible with the unmodified main clause:

(5.9) *For three months, Michael filed two lawsuits.

We observed in Chapter 2 that if modifiers are intersective and do not stand in a scopal relationship to each other, versions without modifiers ought to denote supersets of versions with modifiers. However, here we can't drop one of the modifiers at all, so the two adverbials in (5.8a) cannot be intersective. Nor can *for three months* have interior scope; rather, it must outscope the quantificational modifier. However, if it is a normal verbal modifier, it must modify sets of eventualities (or functions into sets of eventualities) rather than truth values, and thus *every time* modification must yield sets of events.

Similarly, without the quantificational adverbial in (5.8b), if LaToya gave more than one concert in December, the claim made is false:

(5.10) Last December, Michael filed exactly two lawsuits.

So again, the two modifiers are not intersective; furthermore, if we allow the *every time* modifier to take wide scope, we end up claiming that for every concert LaToya gives, Michael files two lawsuits in December, which is not what (5.8b) means. So again, *every time* must have interior scope, and if *last December* is a normal verbal modifier, *every time* must yield sets of events.

Finally, without the quantificational adverbial in (5.8c), we cannot provide the appropriate "donkey" binding for the object pronoun:

(5.11) In December, she dedicates it to Santa Claus.

So again, the modifiers are not intersective, and if *every time* has wide scope we confront the same problem with readings that we found in (5.8b). I conclude, then, that *every time* must yield sets of events. Ignoring genericity and existential closure for the moment, I propose, then, the following revised interpretation of such utterances:

(5.12) Every time the bell rang, Mary opened the door.

(5.13) $\lambda e[\forall e'((ring'(the{-}bell')(e') \wedge e' \leq e) \rightarrow$
$\exists e''(e'' \leq e \wedge open'(the{-}door')(m)(e'') \wedge M(e'') = e'))]$[3]

In other words, *Every time the bell rang, Mary opened the door* denotes that set of events such that for any subevent which is a ringing of the bell, there is a different opening of the door by Mary which is also a subevent. Crucially, the elements in this resulting set of events are process-like or state-like.[4]

It seems, then, that the evidence supports a parallel between verbal modification and CN modification even in the quantificational case. Given this similarity, it might seem even more surprising that the behavior of event-denoting sentence-level constituents in argument positions might differ as considerably from NPs in similar positions.

Before I turn to a range of possible solutions, I want to mention a final detail. These adverbial quantifications are quite commonly closely connected to genericity (cf., for instance, Shubert and Pelletier (1989), Carlson (1989)). It seems that *every time* and *whenever* don't differ much in their quantificational force between the episodic and generic cases;[5] if anything, the generic might be somewhat more "forgiving" than the episodic case:

(5.14a) Last December, every time/whenever LaToya gave a concert, she dedicated it to Santa Claus.
(5.14b) In December, every time/whenever LaToya gives a concert, she dedicates it to Santa Claus.

However, *when* is different. Its episodic use seems to be existential rather than universal, while its generic use remains approximately equivalent to *whenever*:

(5.15a) When LaToya leaves, Michael cries.
(5.15b) When LaToya left yesterday, Michael cried.

If *when* modification yields a constituent of type $\langle \epsilon, t \rangle$ rather than t, this contrast falls out immediately as a contrast between the existential closure operator in (5.2) and the generic closure operator in (5.4). Thus, the interaction between genericity and closure yield an explanation of the differential interpretation of *when*.

5.2 Existential closure and dynamic semantics

The case of adverbial quantification suggests that I was wrong to pursue a parallel between event-denoting NPs, whose types are $\langle\langle \epsilon, \langle \epsilon, t \rangle\rangle, \langle \epsilon, t \rangle\rangle$ and ϵ, and Ss and Vs, which bear the types t and $\langle \epsilon, t \rangle$ respectively. The appropriate parallel seems to be between nominal elements which can be modified – that is, CNs – and sentence-level constituents. CNs bear the type $\langle e, t \rangle$, parallel to the type $\langle \epsilon, t \rangle$ of V, and can be mapped into individuals (say, with the iota operator) or generalized quantifiers (via a determiner). If we assume the same range of possibilities for V, the properties of sentences as a complement of *until* become utterly unsurprising. One might object that unlike the nominal case, there is no surface element corresponding to the options for type-shifting, but the account of cardinal numbers and bare plurals presented in Chapter 3 confronts the same issue, at least in the case of a type-shifter from sets of events to existential generalized quantifiers. On the other hand, what now fails to fit into the pattern of correspondences is our original existential closure operator, since there is no shifter in the nominal system which maps a set of individuals into truth values. Initially, we might decide that this mismatch is simply a consequence of the difference between nouns and verbs. However, I think there is a far more intriguing answer to be had, and it grows directly out of recent work in dynamic semantics. In this section, I will examine some current accounts of dynamic semantics and consider how they address the problem of event closure and reference.

In utterance sequences, indefinite NPs introduce individuals which are available for later anaphoric reference. If indefinite NPs correspond to existential generalized quantifiers, and the scope of these quantifiers does not extend beyond the clause in which the NP appears, then this coreference is somewhat mysterious:

(5.16) A man$_i$ walked in. He$_i$ sat down.

Accounts of dynamic semantics propose principled ways to "extend" the scope of existential quantifiers. Typically, such an account assumes that sentences denote not truth values but rather some sort of operator on *contexts*. Individuals corresponding to the bindings of existential quantifiers (such as the man in the first clause of (5.16)) are introduced into the context, and made available for later anaphoric reference. Dynamic semantics, then, is simultaneously an account of binding and of reference.

In this view, contexts correspond to variable assignment functions (cf. Heim (1982), Groenendijk and Stokhof (1991), Portner (1992)). Indefinite NPs correspond to a dynamic, rather than a static, existential quantifier, which I will notate as $\mathcal{E}\S$. There are two possible strategies for updating the context. In the first strategy, which I will call the *filtering* strategy, a context corresponds to a set of assignment functions, and what an indefinite NP does is serve as a filter for this set. So for instance, if the existential quantifier in the subject position of *A man walked in* quantifies over elements bound to the variable x_1, it will filter out all assignment functions which do not bind x_1 to some element of man':

(5.17a) $man' = \{j, l\}$

(5.17b) $g_1: \quad x_1 \rightarrow m$
$\qquad\qquad x_2 \rightarrow l$
$\qquad\qquad \ldots$
$\qquad g_2: \quad x_1 \rightarrow j$
$\qquad\qquad x_2 \rightarrow m$
$\qquad\qquad \ldots$

(5.17c) $[\![\text{A man walked in}]\!](\{g_1, g_2, \ldots\}) = \{g_2, \ldots\}$

So in this strategy, sentences denote functions from sets of assignment functions to sets of assignment functions. In the second strategy, which I will call the *modification* strategy, a context is a single assignment function, and what indefinite NPs do is "set" one of the values of the assignment function. So if, as before, the existential quantifier in the subject position of *A man walked in* quantifies over elements bound to the variable x_1, it will map an assignment function g to that set of assignment functions g' which agree with g in all aspects except possibly its assignment for x_1, and furthermore assign x_1 to some element of man':

(5.18a) $man' = \{j, l\}$

(5.18b) $g: \quad x_1 \rightarrow m$
$\qquad\qquad x_2 \rightarrow l$
$\qquad\qquad \ldots$
$\qquad g'_1: \quad x_1 \rightarrow j$
$\qquad\qquad x_2 \rightarrow l$
$\qquad\qquad \ldots$
$\qquad g'_2: \quad x_1 \rightarrow l$
$\qquad\qquad x_2 \rightarrow l$
$\qquad\qquad \ldots$
$\qquad \ldots$

(5.18c) $[\![\text{A man walked in}]\!](g) = \{g'_1, g'_2, \ldots\}$

So in this second strategy, sentences denote functions from assignment functions to assignment functions. Portner (1992) embodies the first approach, Groenendijk and Stokhof (1991) the second.

Since sentence denotations map contexts to contexts, sequences of sentences are not "reversible" in principle. Each sentence is evaluated in the context C yielded by the previous sentence. In this way, the context evolves through the discourse. This asymmetric interpretation of sentence sequences is taken to be the semantics of conjunctions of sentences as well. The result is that the semantics of sentence sequences and conjunction involve composition. Given these observations, the interpretation of S_1 *and* S_2 is approximately

(5.19) $[\![\mathrm{S}_1 \text{ and } \mathrm{S}_2]\!] = \lambda C[[\![\mathrm{S}_2]\!]([\![\mathrm{S}_1]\!](C))]$

This exposition is a radical oversimplification of the program of dynamic semantics in any of its incarnations, but it will set the stage appropriately for the discussion to come.

Given the hypothesis of existential closure in event semantics, one might ask whether this existential quantification is dynamic as well. Since anaphoric reference to events introduced by existential closure is just as possible as anaphoric reference to individuals introduced by existential quantifiers, the answer seems to be yes, since both types of existential quantification are closed off by the time the anaphor is encountered:

(5.20) LaToya met a bass player yesterday. It happened in the grocery store.

It should come as no surprise, then, that a number of researchers have already investigated the connection between existential closure and dynamic semantics. The approaches that I will concentrate on are those of Portner (1992) and Dekker (1993).

5.2.1 Portner

Portner (1992) is a serious attempt to draw a parallel between the meanings of sentences and the meanings of indefinite NPs. The mechanisms that he exploits draw a great deal from the file-change semantics of Heim (1982). In the discussion to follow, I am going to elide a wide range of details of Portner's account. Among other things, I am going to suppress most of the indices of evaluation in Portner's semantics, such as the model and the utterance situation (which fixes referents for indexical elements). Furthermore, I will ignore Portner's context set C, which allows him (as it allows Heim) to state novelty and felicity conditions on definites, indefinites, and pronouns. What I will preserve is evaluation of meaning relative to an assignment function and a situation.

Portner uses situations instead of worlds as his evaluation indices because he intends to use situations as his Davidsonian elements. As I suggested above, Portner adopts the filtering strategy for dynamic semantics, but his filtering strategy has a twist: contexts are not simply sets of assignment functions, but sets of pairs of assignment functions and situations. The basic type of denotations of sentences are sets of situations, in the standard Davidsonian tradition, and Portner's dynamic update function effectively shifts these sentence denotations into functions from contexts to contexts.

So sentences, for Portner, denote functions from situations (that is, evaluation indices) to truth values, and are thus automatically intensional; at the same time, the $\check{}$ operator of Montague corresponds to determining if the evaluation index (that is, a situation) is in the denotation of the sentence. Given this background, we can define Portner's update operator $\oplus$ as a function which combines a set C of pairs of assignment functions and situations $\langle g', s' \rangle$ and a sentence S evaluated at indices g, s and produces a subset of C such that s' is in the denotation of S evaluated at indices g', s:

(5.21) $C \oplus [\![S]\!]^{g,s} = \{\langle g', s' \rangle | \langle g', s' \rangle \in C \wedge [\![S]\!]^{g',s}(s') = 1\}$[6]

So as the linguistic situation evolves, the set of eligible contexts becomes smaller and smaller.

Crucially related to this definition is the way Portner treats indefinite NPs. Like Heim (1982), Löbner (1985) and others, Portner assumes that indefinite NPs denote sets of individuals, and indefinite NPs decorated by indices (assuming a GB-style syntax) implicitly denote atomic propositions. So $[\![$[NP$_i$ a cat]$]\!]$, at some stage, is true iff x_i is a cat.

Now, note that indefinite NPs do not denote individuals or generalized quantifiers. So their type induces a mismatch with argument positions of predicates which require individuals. For Portner, this mismatch induces Quantifier Raising (QR), which leaves a trace with the same index as the raised NP; the trace is interpreted as the individual variable with the appropriate index. So the logical form of *A man ran* is approximately[7]

(5.22) [IP [NP$_i$ a man] [$\bar{\text{I}}$ [I PAST] [VP e$_i$ run]]]

The interpretation of the indexed NP *a man* is $man'(x_i)$, which is of type t. The interpretation of the VP is that set of situations which support $run'(x_i)$, which is of type $\langle \epsilon, t \rangle$. Portner's intention is to treat this sort of LF as a dynamic conjunction, subject to repeated applications of the update function in (5.21). However, $man'(x_i)$ is the wrong type to be taken as a matrix-level sentence interpretation, so Portner's final step in the manipulation of indefinite NPs is to make them intensional. Thus, the context which results from processing *A man ran* is the result of processing $\hat{}man(x_i)$ and then processing $run(x_i)$.

So this account doesn't really involve existential closure *per se*; instead, the context is narrowed by admitting only those situations which are in the denotation of the current sentence. Indefinite NPs are handled in the same way (once they're intensionalized). So in some sense, by appealing to a dynamic semantics, Portner, like Heim (1982) before him, has eliminated the need for a special operation of existential closure; furthermore, he has reinforced the parallelism between nominal and verbal sets of individuals, although at the cost of assuming that CNs and indefinite NPs denote objects of the same type. Event-denoting constituents like gerunds in argument positions are handled in a parallel way. Portner adopts the standard GB account of embedded VPs, assuming that they are clausal. For Portner, that means that they denote sets of Davidsonian elements (situations). Predicates like *regret* semantically take an internal event individual, so the clausal gerund complement induces the same type mismatch that indefinites induce, and QR is triggered:

(5.23a) Mary regretted climbing Mount Rushmore.
(5.23b) [IP [NP$_i$ PRO$_j$ climbing Mount Rushmore] [IP [NP$_j$ Mary] [$\bar{\mathrm{I}}$ [I PAST] [VP e$_j$ regret e$_i$]]]]

As I suggested above, these adjoined structures are interpreted as dynamic conjunctions for Portner. Since gerunds already denote sets of individuals, they do not need to be intensionalized before they are interpreted, unlike indefinite NPs. In some sense, then, by invoking QR, Portner reduces the embedded case to the matrix case.

So for Portner, the parallel between nominal and verbal elements is fairly complete. He declines to deal with indefinites as generalized quantifiers, and treats them as sets of individuals; and dynamic interpretation takes him the rest of the way, by eliminating the need for an operation of matrix existential closure. However, he crucially requires a level of LF to achieve these results. With these observations in mind, let's turn to a second, very different proposal, that of Dekker (1993).

5.2.2 *Dekker*

Dekker concerns himself with applying the tools of dynamic semantics to a range of "implicit" semantic arguments: complements of relational nouns, Davidsonian event arguments, etc. Dekker adopts a form of the dynamic semantics of Groenendijk and Stokhof, so his technique for context update is the modification strategy. Dekker explores the applicability of a technique called *existential disclosure*, which exploits the ways in which dynamic existential quantification differs from normal existential quantification.

In order to understand the significance of Dekker's proposal, let's ask a very basic question: why must existential closure over events wait until the V level? Why can't verbs come with existential closure "built in"? In such an account, lexical verbal meanings would not exhibit an event argument, but events would already be incorporated, very much as thematic roles are incorporated in the lexical neo-Davidsonian account:

(5.24) $[\![\text{wash}]\!] = \lambda y \lambda x[\exists e(wash'(y)(x)(e))]$

In this way, we could incorporate events in our representations, which we know we need, but wouldn't have to worry about existential closure. However, this proposal has a fatal problem: we need to refer to the event. The whole point of Parsons' and Landman's argument for events based on the properties of modification, elaborated in Chapter 2, is that verbal modification, like nominal modification, is essentially *intersective*; that is, it is a conjunction of predicates over events. If we close off the event argument via existential quantification, we no longer have any way to construct such a predicate based on the head verb.[8]

What Dekker proposes is that by exploiting the fact that dynamic existential quantification leaves elements available for subsequent reference, we can existentially close off an argument (such as a Davidsonian event argument) without closing off the possibilities for subsequent reference. For Dekker, existential disclosure comes in many forms. For instance, if we want to specify an identity for a previously existentially quantified element, we can introduce an equality between the relevant variable and the individual which specifies it. If, on the other hand, we wish to specify further restrictions on a known variable, we merely need to know that variable's index. It is this latter case that Dekker invokes when dealing with existential closure.

Dekker proposes that Davidsonian verbs emerge from the lexicon with their event argument existentially closed by a dynamic existential quantifier. So the denotation of *walk* is approximately

(5.25) $\lambda x[\mathcal{E}\S e(walk'(x)(e))]$

I say "approximately" for two reasons. First, I have ignored the fact that all variables and constants must be of the appropriate dynamic type, which is an implementational detail which is not relevant here. Second, I have ignored the indices on the variables, to which we now turn.

In Montague's PTQ, pronouns are infinitely ambiguous among the range of potential indices they can assume: *he*$_1$, *he*$_2$, *etc.*. Each subscripted pronoun denotes the corresponding indexed variable. This ambiguity is required because pronouns are essentially free variables in Montague's system, and must be distinguished from one another; if we wish to bind some occurrence of *he*, we must make sure that we do not bind all other occurrences of *he* by accident:

(5.26) Michael hates his producer$_j$. *Michael*$_i$ *thought he*$_j$ *said that he*$_i$ *should use fewer synthesizers.*

Determiners, on the other hand, are unambiguous in Montague's system, because they provide a "roof" for binding, and it can be proven that the principle of alphabetic variants holds, so the variable being quantified over can be freely renamed without altering truth conditions.

But determiners aren't unambiguous in dynamic semantics. Recall that what indefinite NPs do is fix the value of some variable and "pass on" that value by altering an assignment function (or restricting the set of assignment functions). In other words, existential quantification no longer serves as a "roof" for binding; that's the whole point of dynamic semantics. But that means the variables fixed by existential quantification are essentially free, and subject to the same dangers as pronouns are in PTQ. So determiners must be ambiguous among all possible indices as well. This is the case in Dekker's system, but his system is not alone in making this requirement; the accounts of Chierchia and Groenendijk and Stokhof must do the same:

(5.27) $[\![\mathrm{a}_i]\!] = \lambda P \lambda Q[\mathcal{E}\S x_i(P(x_i); Q(x_i))]$

Now, it ought to be clear at this point that *any* element which introduces a dynamic existential quantifier must be ambiguous in this way. And here is where the details I omitted from (5.25) become important. Because Davidsonian verbs, for Dekker, incorporate a dynamic existential quantifier over their event argument, they must be ambiguous among all possible indices for the event:

(5.28) $[\![\mathrm{walk}_i]\!] = \lambda x[\mathcal{E}\S e_i(walk'(x)(e_i))]$

But the inelegance doesn't end there. Any element which modifies this event variable must be ambiguous among all possible indices as well, since it must reference that particular variable (as a free variable). So (simplifying Dekker's account somewhat) the locative preposition *from* would have to look like this:

(5.29) $[\![\text{from}_i]\!] = \lambda y \lambda P \lambda x[P(x); from'(y)(e_i)]$

The VP *walks from Boston* will reduce as follows:

(5.30) $[\![\text{walks}_i \text{ from}_i \text{ Boston}]\!] =$
$\lambda y \lambda P \lambda x[P(x); from'(y)(e_i)](b)(\lambda x[\mathcal{E}\S e_i(walk'(x)(e_i))]) =$
$\lambda x[\mathcal{E}\S e_i(walk'(x)(e_i)); from'(b)(e_i)]$

By the principles of dynamic semantics, the value for the variable e_i will be available for subsequent reference beyond the scope of the dynamic existential quantifier.[9]

This approach is considerably different from the two others we've seen. It seems to solve one of our problems; the default type of Davidsonian predicates is now the dynamic equivalent of t, not $\langle\epsilon, t\rangle$, but embedded clauses are still a problem. But Dekker's account derives this advantage simply by introducing existential closure at a much earlier point, and in the process it vastly multiplies the range of ambiguities found in the lexicon. In this light, Dekker's proposal doesn't seem like much of an advantage.

5.2.3 A sketch of a solution

I suspect that while the dynamic account is on the right track, neither Dekker's approach nor Portner's really addresses the problem. In this section, I will propose a possible solution, although actually pursuing this direction of research is far beyond the scope of this study.

First, the dynamic program can impose some distance from concerns of truth. Note, for instance, that in Portner's update function, there is no need for bare sentences to ever denote truth values; sentences can be incorporated directly as sets of Davidsonian elements, simply because what is important is not truth but context update. Dekker encodes the update information directly into each verbal predicate, and in some sense truth is not relevant for him either. So in the dynamic program, the issue of existential closure is replaced by the question of how to introduce described events into the context.

In Dekker's case, however, and in Chierchia (1992) as well, the parallel with static generalized quantifiers is drawn quite rigidly. It is a dynamic quantifier which introduces elements into the context, and indefinite NPs still denote generalized quantifiers, albeit dynamic generalized quantifiers. But even if we were to assume that we could shift event sets into generalized quantifiers, that would still leave the existential closure operation itself without a parallel in the nominal system.

Is this lack of parallelism something we just have to live with? As I suggested above, I don't think so. In particular, I think that we can motivate a different account based on problems with dynamic semantics. The approach that Chierchia, Dekker, etc. take to introducing elements into contexts in dynamic semantics is to use a dynamic existential quantifier as a way of "mentioning" an individual. By virtue of being bound and introduced into assignment functions, the individual is "mentioned", and is subsequently available for reference. However, there's something strange about this strategy, because it does not elevate the elements "mentioned" by indefinites above any other individual assigned to any other variable in the relevant assignment functions. For instance, in the update strategy, if *a man* in (5.31) corresponds to an existential quantifier which maps g to a g' in which j, the denotation of *Jermaine*, is assigned to x_1, lots of other bindings are also provided by g'; for instance, it might map x_{145} to m, the denotation of *Michael*. So if we interpret *he* as x_{145}, (5.31) describes a situation in which Jermaine walks in and Michael sits down:

(5.31) A man walked in. He sat down.

Now, one might quickly point out that this interpretation is certainly a possible interpretation of (5.31), but I would respond that this possibility arises only if (5.31) is not the initial discourse segment or if *he* is interpreted deictically. Nevertheless, even if this interpretation is generally possible, there is a much deeper problem involved here.

Consider the nature of assignment functions. If there are infinitely many variables, assignment functions can have infinite domains. Furthermore, pronouns are potentially ambiguous among all possible variables, which means they are potentially infinitely ambiguous if we assume infinitely many variables. Dynamic existential quantifiers restrict the value of a single variable in the assignment function; but this imposes no restriction on which individuals are available for subsequent reference, since we have infinitely many variables to assign individuals to. And since pronouns are ambiguous among all these variables, no restrictions are imposed on what any given pronoun might refer to. In other words, restricting the assignment function does no work at all in (5.31).

The situation is barely better in "donkey" sentences. If we pick the same variable for *a donkey* and *it* in *Every farmer who owns a donkey beats it*, we have an account of the quantificational effects of this sort of transmission of individuals through variable assignments. However, considering that there are infinitely many variables, the chances of achieving this coreference through selecting the same variable for the two constituents is infinitely small.

The problem is not dynamic semantics; the problem is using variables and assignment functions as contexts. So what if we "mentioned" elements differently? What if contexts were exactly the individuals which had been "mentioned"? This is strongly reminiscent of the original account of Kamp and Heim. In an account such as this, indefinites might actually correspond to individuals which are introduced into the context, and existential closure would turn into "mentioning" an event. If we could construct such an account, the same advantages of parallelism which Portner derived might be ours as well, but without a level of LF and with a more plausible type for indefinite NPs.

I cannot flesh out such an account here; however, I can point in one promising direction. van Eijck (1993) draws parallels between dynamic semantics and the semantics of programming languages and makes some tempting suggestions. He points out that alongside the ι description operator, which is definite and maps a set into an individual, Hilbert and Bernays (1939) introduce the η description operator, which is *indefinite*. This operator essentially corresponds to an arbitrary choice function. Although van Eijck does not present a fragment, it is clear from his discussion that he intends the η operator to be the interpretation of the indefinite article. If we could set up a semantics which used this operator to make sentences (and indefinite NPs) denote individuals, we could address the asymmetry implied in the operation of existential closure once and for all. Furthermore, the idea that sentences mention events seems to correspond quite well with the view of Lasersohn (1995), who addresses the closure problem by regarding sentences as demonstratively referring to eventualities in such a way that the sentence is true if the eventuality satisfies it and false otherwise. Lasersohn's idea originates in Austin (1950), which is developed extensively in Barwise and Etchemendy (1987).

But what of the generic closure operator in (5.4)? Can it be construed as an individual as well? If we wish to speculate further, we might attempt to draw parallels between individual correlates of sets of individuals (such as bare plurals and mass nouns as discussed in Chierchia (1982)) and generics. Perhaps generics are individual correlates of sets of events. It is hard to know how one might verify such a hypothesis; most of the tests which Chierchia reviews as tests for nominalizations involve scopal properties of such elements in argument positions. However, event-denoting generic statements cannot be arguments of episodic predicates, and thus it's very hard to tease apart any of the scopal properties.

The area of existential closure and its relationship to dynamic semantics is a separate study; I cannot claim that what I've proposed here is any more than a crude suggestion about where to look. Therefore, in the remainder of this thesis I will revert to the unsatisfying proposal embodied in (5.2), on the grounds that it is at least observationally adequate. However, I reach this conclusion reluctantly, convinced that there is a better way of doing existential closure which is beyond the scope of this thesis.

5.3 The size of events

The other devilish detail which, to my mind, has been dealt with a little too briefly in the literature is the matter of the size of events. In this section, I will argue that events must be as small as possible, in lattice-theoretic terms.

5.3.1 Events and persistence

We saw in Chapter 2 that situations can "grow", and in general we've identified the need to sum up events into larger events. So in thinking about how big events can be, it doesn't matter whether what we choose as our Davidsonian element; as long as they enter into lattice-theoretic relationships, events can be quite large or quite small. What might these two alternatives look like? Let's say that we have an event e_1 associated with LaToya washing her car on Tuesday at 4 PM:

(5.32) $wash' = \{\ldots, \langle e_1, l, c\rangle, \ldots\}$

We can say that e_1 *is* the event of LaToya washing her car; or, alternatively, we can say that LaToya washes her car *in* e_1. In the former case, the event is minimal; in the latter case, it is not necessarily so. In the case of atomic events, as Lasersohn (1995) notes, there is a quite straightforward correspondence between the two accounts, since atomic events are necessarily minimal. Let $At_{\mathcal{E}}$ be the set of atomic events. For any particular set of atomic events $P_{min} \subseteq At_{\mathcal{E}}$, we can define a corresponding set of not necessarily atomic events P_{nonmin} as that set of events each of which has some element of P_{min} as a part:

(5.33) $P_{nonmin} = \{e | e \in \mathcal{E} \wedge \exists e'(e' \in P_{min} \wedge e' \leq e)\}$

So in the nonminimal account, an event which is in the denotation of *LaToya washes her car* can have many more things going on in it besides the washing event.

Lasersohn (p.c.) offers an alternative account of event minimality, one where the minimality of an event is relativized to particular propositions. So some event e might be minimal with respect to the proposition *Michael strums* (that is, it encompasses only one such event), while it might be nonminimal with respect to the proposition *Michael strikes a guitar string* (that is, it encompasses many such events). Krifka (p.c.) assumes a similar architecture. The contrast between this notion of minimality and the one I've presented recalls the contrast between *liberal* and *conservative* accounts of lattice-theoretic join discussed in Section 3.4. The liberal account extends the join operation to cover relations like member-of and part-of, while the conservative account limits the join operation to supporting plurality and conjunction and nothing more. So individuals in the liberal account are atomic only with respect to a particular predicate. By these criteria, the sort of account Lasersohn proposes here is clearly a liberal one, and shares a great deal with Kratzer's view of situations as slices of the world; a slice of the world which supports the proposition *Michael strums* cannot help but support the proposition *Michael strikes a guitar string*.

As I stated in Chapter 3, in this thesis I adopt for both objects and events the opposing conservative account of atomicity, where the set of atoms is absolute and the member-of and part-of relations have nothing to do with the lattice-theoretic join operation which supports plurals and conjunction. This assumption is incompatible with adopting situations as Davidsonian elements, because situations are only atomic with respect to propositions. If a situation s_1 is to be an atomic Davidsonian element of

Michael strumming, it must be an element of the set $At_{\mathcal{E}}$. However, we know that it cannot be a member of this set, because it is a nonatomic Davidsonian element of Michael striking a guitar string. In fact, it is probably impossible to identify any useful set of elements $At_{\mathcal{E}}$ of situations, given that they are instantiations *par excellence* of the liberal account.[10]

Now, in Chapter 2 I motivated using situations as Davidsonian elements specifically because they're small. However, under the nonminimal interpretation of Davidsonian semantics, the Davidsonian elements can get quite large again. Why in the world would we backtrack in this way? The answer has to do with persistence.

If we view things in situation-theoretic terms, it is an axiom that for any proposition p, the set of situations which makes p true is persistent. But what about sentence denotations? We have assumed that the denotation of any sentence V is a set of Davidsonian elements which intuitively "makes the sentence true". Should we assume that if some Davidsonian element e is in the denotation of V, then any $e' > e$ will be in the denotation of V as well? Intuitively, we are asking if these larger Davidsonian elements also "make the sentence true"; technically, we are asking if sentence denotations are persistent in a manner parallel to the structure of situations.

Krifka (1989), Lasersohn (1995) and Kratzer (1989) all assume that the answer is yes. However, this assumption initially runs afoul of sentences containing downward-entailing contexts. Say, for instance, that LaToya writes three songs, and that these minimal songwriting events are e_1, e_2 and e_3. Of what events is *LaToya wrote fewer than three songs* true? It would seem to be true of the individual songwriting events, which are certainly events of LaToya's writing fewer than three songs. However, *LaToya wrote fewer than three songs* is *not* true of the sum of these events $e_1 + e_2 + e_3$. Since the sum of these three events is by definition a larger event than its individual parts, if any of e_1, e_2, e_3 are in the denotation of *LaToya wrote fewer than three songs*, then we cannot maintain that events are persistent, since *LaToya wrote fewer than three songs* is true in a smaller event (say, e_1) and false in a larger event ($e_1 + e_2 + e_3$). Rather than give up persistence of event denotations, Lasersohn, Krifka and Kratzer all conclude that e_1, e_2 and e_3 are *not* in the denotation of *LaToya wrote fewer than three songs*. For Lasersohn, the solution is to require that *LaToya wrote fewer than three songs* consists of events which are "too big to fail"; that is, each event e must support the writing of fewer than three songs by LaToya, and must be big enough such that there is no $e' > e$ which contains additional songwriting by LaToya which might make the sentence false. Krifka is motivated by the same concerns, but he assumes, more simply, that the events in sentence denotations involve maximal events at a certain time, rather than events which are maximal with respect to a certain type of task. Both Lasersohn and Krifka extend this requirement of maximality – harmlessly, they feel – from downward-entailing contexts to all types of complex events built by quantification, and in Lasersohn's case to all events.[11]

The case of downward-entailing contexts seems to present a stark choice between minimality of events and persistence of sentence denotations. I will argue, in the sections to follow, that events must be minimal. Thus, I will conclude that sentence denotations are not persistent. First, I will present my argument; then I will return to the issue of downward-entailing quantification and consider the implications of my conclusion.

5.3.2 *Toward minimality*

As I suggested, a nonminimal account of sentence denotations is motivated entirely by a desire to retain persistence as a property of sentence denotations in the face of downward-entailing quantifiers. None of the frameworks which postulate some sort of maximal event in this context actually require them in any other. In this section, I will demonstrate that, at the very least, the invocation of nonminimality must be restricted, since adopting some version of nonminimality for descriptions of atomic events is almost certainly untenable.

Interestingly enough, the arguments against nonminimality parallel quite closely the arguments in favor of events found in Chapter 2. The reason, of course, is that the primary motivation for events (or a similarly fine-grained view of situations) is that elements like times or spatiotemporal locations are not fine-grained (read: small) enough to account for the properties of event modification, reference, and quantification. For instance, let's return to (2.9):

(2.9) Brutus stabbed Caesar in the back through his toga with a knife.

Recall that Parsons and Landman showed that the PP modifiers in this example behave like nominal intersective modifiers behave, and that the only reasonable explanation for this behavior was that like nominal intersective modifiers, these modifiers were predicates over a common argument, namely, an event. Given what we've said so far, and without concerning ourselves with the internal structure of the PP meanings, a reasonable interpretation for (2.9) is (5.34):

(5.34) $\lambda e[stab'(caesar')(brutus')(e) \wedge in{-}the{-}back'(e) \wedge$
$through{-}his{-}toga'(e) \wedge with{-}a{-}knife'(e)]$

Let's call the minimal event of Brutus stabbing Caesar e_{stab}. Assume furthermore that Brutus stabbed Caesar exactly once in this world, and not with a knife but with a pitchfork. So $with{-}a{-}knife'(e_{stab})$ is false. Finally, assume that in the same world, there is a minimal event e_{carve} which consists of Jermaine carving a turkey with a knife. So $with{-}a{-}knife'(e_{carve})$ is true.

Now, under any assumption of nonminimality, sentence denotations consist of all those events which have some relevant minimal event as a part. So the set of events $\lambda e[stab'(caesar')(brutus')(e)]$ is that set of events each of which has an event of Brutus stabbing Caesar as a subpart. A similar generalization holds for the denotations of PP modifiers. Thus we have

(5.35a) $\lambda e[stab'(caesar')(brutus')(e)] = \{e_{stab}, e_{stab} + e_{carve}, \ldots\}$
(5.35b) $\lambda e[with{-}a{-}knife'(e)] = \{e_{carve}, e_{stab} + e_{carve}, \ldots\}$

The nonatomic event $e_{stab} + e_{carve}$ is in the denotation of both event predicates, and thus in their intersection. Therefore, a nonminimal account predicts that the set of events denoted by *Brutus stabbed Caesar with a knife* will be nonempty, even though Brutus didn't stab Caesar with a knife. The problem, of course, is that nonminimal events aren't "small" enough to guarantee that predicates which codescribe an event set are intuitively predicates of the same eventualities.[12]

At this point, a defender of the nonminimality hypothesis might respond that the nonminimal account I criticize here is too general. We don't want nonminimal event sets to contain *every* individual larger than the relevant atomic ones; we clearly need to restrict nonminimality in some way. Krifka's account for quantified events, for instance, restricts the nonminimal event set to maximal events whose parts share the same time; Portner's account of concrete events for event nominals restricts the nonminimal situation set to situations whose parts share the same spatiotemporal location. For the sake of completeness, we can demonstrate that a Krifka-style proposal must not apply to atomic event sentences for the same reason as Lasersohn's, simply by setting up the example so that the time of e_{stab} is the same as the time of e_{carve}. It is just as straightforward to show that a Portner-style account is incorrect as well. Recall (2.12):

(2.12) Michael won the race by limping across the finish line.

Like (2.9), (2.12) is an example of intersective event modification; the denotation of (2.12) is given by the intersection of the denotations of *Michael won the race* and *by limping across the finish line.* As I argued in Chapter 2, the objects in these denotations could not be spatiotemporal locations. Let's say that Michael wins the race, and at the instant he crosses the finish line he collapses from fatigue. It is quite reasonable, then, to conclude that the spatiotemporal location at which Michael wins the race is exactly the same spatiotemporal location at which Michael collapses from fatigue. If Davidsonian elements are no more fine-grained than spatiotemporal locations, then the event set denoted by *Michael won the race* overlaps with the event set denoted by *Michael collapsed from fatigue*, and Portner-style account of nonminimality would predict that (2.15) holds:

(2.15) Michael collapsed from fatigue by limping across the finish line.

However, (2.15) is meaningless. Therefore, restricting nonminimal events to contain parts which share the same spatiotemporal location is not enough.

The facts of event quantification and reference make the same point. Consider (2.39), repeated here:

(2.39) When a train breaks down, it usually happens without anyone watching.

I argued in Chapter 2 that these examples cannot be accounted for by adopting spatiotemporal locations as Davidsonian elements. The same point can be made about nonminimal events which cooccur at a given spatiotemporal location. Assume that e_b is a minimal event of a train breaking down, and that it is raining during this event. Call the subpart of the raining event which overlaps temporally with the breakdown e_r. It is quite reasonable, then, to conclude that e_b and e_r share a spatiotemporal location, and that the denotation of *a train breaks down* includes the nonminimal event $e_b + e_r$. So events which share a spatiotemporal location become a sort of equivalence class in the nonminimal account, and end up being no better and no worse that spatiotemporal locations themselves as Davidsonian elements. And as we saw in Chapter 2, spatiotemporal locations are not fine-grained enough to distinguish between the breakdown and the rain.

The obvious response to these last two arguments is that while it might be reasonable to conclude that these pairs of events share a spatiotemporal location, it is also possible to conclude that they do not. That is, while a critic of nonminimality might claim that e_b and e_r have exactly the same spatiotemporal location, it is probably impossible to *prove* that they do. It is this uncertainty which makes spatiotemporal locations so tempting as Davidsonian elements: there is a possibility that spatiotemporal locations can be differentiated in a fine-grained enough way that they can serve as "hooks" for event predication and reference.

Let's review for a moment. We saw that an account such as Lasersohn's which places no restrictions on the size of events is incompatible with plausible accounts of event modification and reference. We also saw that a Krifka-style account, which places only temporal restrictions on the size of events, does not work either, for exactly the same reasons. We've now seen that the Portner-style restrictions have a chance of being fine-grained enough to make the appropriate distinctions. So will spatiotemporal locations save the day for the nonminimality hypothesis? Not at all. First, we've only looked at codescription of and reference to atomic events, and atomic events are not the objects which motivate a nonminimal account of events. Second, what we've shown, once again, is that Davidsonian elements must be fine-grained enough to differentiate atomic events from one another; it should be obvious that the only way to make spatiotemporal locations fine-grained enough to accomplish such a goal is to make them stand in one-to-one correspondence with atomic events. In order to really test the hypothesis, we need to turn to the cases which motivated the nonminimal account in the first place: nonincreasing quantification.

5.3.3 Nonminimality and nonincreasing quantifiers

In order to demonstrate that nonincreasing quantifiers cannot be nonminimal either, I need to appeal to the facts of event reference, as I have previously. But there's a nagging property of event reference which might interfere with the arguments being presented here, which I will now address. The problem is that *it*, when anaphoric to sentences, "drifts" between (at least) episodic event reference, property reference, relation reference and generic event reference quite easily:

(5.36a) LaToya kissed Michael. It happened in the garden.
(5.36b) LaToya kissed Michael. Jermaine did it too.
(5.36c) LaToya kissed Michael. Jermaine did it to Janet immediately afterward.
(5.36d) LaToya kissed Michael yesterday, but it's rare.

Even when *it* does not appear in a context which forces some substitution of participants as in (5.36b) and (5.36c), generic contexts can force abstractions. So (5.37) can have the reading that people get hit by cars frequently, in addition to having the (less plausible) reading that LaToya does:[13]

(5.37) LaToya got hit by a car last night. It happens a lot around here.

Under these circumstances, how can we guarantee that *it* truly refers to events? The key is that the *whenever*-type contexts we've relied on do not license generic reference. So while *it* in (5.37) refers most plausibly to the generic event of people being hit by cars, it cannot in (5.38), even if the adverbial modifier is also in a "generic" tense:

(5.38) *Every time/whenever LaToya gets hit by a car, it happens a lot around here.

Similarly, the adjective *rare* only modifies kinds (cf. Carlson (1977), for instance), but in contrast to (5.36d), the argument of *rare* cannot refer to the kind individual corresponding to LaToya kissing Michael in (5.39c):

(5.39a) Boys are rare.
(5.39b) *John is rare.
(5.39c) *Every time/whenever LaToya kisses Michael, it's rare.

I conclude, therefore, that *it* appearing in event containers like *happen* within subordinating constructions with quantificational force cannot exhibit generic event reference, and must refer to some episodic event.

So consider (5.40):

(5.40) King Edward took a walk through the arboretum once a day, and the crows living in the knotty pine by the drawbridge loved to peck on his crown. Most of the time the whole flock would harass him, and they took their time doing it, too. But sometimes only a few crows bothered him, and *whenever no more than three crows pecked King Edward, it was over quickly.*

The clause that concerns us is the italicized clause *whenever no more than three crows pecked King Edward, it was over quickly.* That is, for each event/situation of no more than three crows pecking King Edward, that event/situation was over quickly. How big is such an event? Those who argue that sentence denotations are persistent must make it large enough to guarantee that there is no fourth crow pecking King Edward. Such an account must, at the very least, encompass everything else which is going on in the spatiotemporal location where King Edward is being pecked. But how big is that spatiotemporal location? It can't be *too* small. If three crows are pecking one side of King Edward's crown, for instance, the spatiotemporal location must certainly cover the other side of King Edward's crown as well, for instance, just to make sure there are no crows over there too. But let's say it's raining on King Edward, just as it was raining on the train while it broke down. In this case, it seems impossible to make the spatiotemporal location under consideration large enough to rule out any other crows, but still small enough to rule out the rain. That is, if we insist that sentence denotations are persistent, we can't tell what's over quickly, the rain or the pecking, because we simply can't make our spatiotemporal location small enough and still guarantee persistence.

The problem is actually somewhat more complex than I've suggested so far. I think it's possible to argue that at least in the case of downward-entailing quantification, what's at issue is not the size of the event at all. It turns out that in some unusual circumstances, the event containers discussed in Chapter 2 can indeed host negative sentences. Consider a variant of (5.40) above:

(5.41) King Edward took a walk through the arboretum once a day, and the crows living in the knotty pine by the drawbridge loved to peck on his crown. Most of the time the whole flock would harass him, and they took their time doing it, too. But sometimes only a few crows bothered him, and sometimes they left him alone entirely.

And whenever no crows pecked King Edward, he wished it would never end.

In this example, King Edward has a counterfactual desire about an event of no crows pecking him. Now, no matter whether we take our Davidsonian elements to be situations or events, applying minimality to this sort of negative sentence seems incoherent. If we adopt a liberal, situation-like view of Davidsonian elements in which these elements can be minimal with respect to some proposition (say, *No crows pecked King Edward*) but not others (say, *Three crows hovered over King Edward*), then the set of minimal events with respect to *No crows pecked King Edward* will contain the set of absolutely minimal events at the relevant time, since every event at that time supports the truth of *No crows pecked King Edward*, and we want the smallest ones. However, it's not clear that under this view there *is* such a thing as a minimal event, and even if there is, every negative statement true over the same time interval will denote the same set of events. If we adopt a conservative view of events where the elements of lexical event predicates do not have subparts of a different ontological sort (so an event in the denotation of *LaToya kissed Michael* is an atom, and has no subpart equivalent to some element in the denotation of *LaToya moved her lips*), then the meaning of *No crows pecked King Edward* is even odder; if we adopt a meaning of *no* which makes the same Davidsonian adjustments as those made for *a(n)* in (4.31), repeated here, then we get (5.42):

(4.31) $[\![\text{a}]\!] = \lambda P \lambda E \lambda e[\exists x(P(x) \wedge E(x)(e))]$

(5.42) $[\![\text{no}]\!] = \lambda P \lambda E \lambda e[\neg\exists x(P(x) \wedge E(x)(e))]$

But under this interpretation, given minimality, *no crows pecked King Edward* is that set of atomic events which isn't an event of a crow or crows pecking King Edward, which also doesn't pick out the right set. So assuming minimality in this case doesn't seem to work.

Furthermore, for the same reason as for (5.40), the denotation of *No crows pecked King Edward* can't encompass everything at a particular spatiotemporal location, either. That is, it can't be small, and it can't be big. So what's going on? What seems to me to be happening is that *no crows pecked King Edward* is that set of events which are *notable* for having no crows pecking King Edward, namely that portion of King Edward's daily constitutional which takes him past the knotty pine by the drawbridge.[14] That is, while *no crows pecked King Edward* describes these events, it clearly "describes" other events as well; it's just that those other events aren't relevant.

That is, the size of the events is not the issue; the expectation of their content is. In some sense, *no crows pecked King Edward* is anaphoric, that is, contextually dependent on a previously established set of events or situations. In other words, the proposal that sentence denotations are persistent is simply a crude attempt to import contextual restrictions into event semantics. Increasing quantification gives us similar, albeit subtler, evidence for this position. Consider a final variant of (5.40):

(5.43) King Edward took a walk through the arboretum once a day, and the crows living in the knotty pine by the drawbridge sometimes pecked on his crown. Most of the time only a few crows harassed him, but sometimes the whole flock got into the act. Flocks of crows tend to disperse rather quickly, though, so *whenever at least ten crows pecked King Edward, it only lasted a few minutes.*

If King Edward is pecked by a flock of crows by the drawbridge, and they disband, and a minute later a lone crow swoops down and pecks him, it doesn't seem to me that this last crow "counts" in some sense; that is, this last pecking cannot extend the pecking time in such a way that (5.43) is falsified. That is, the context I've assumed implicitly restricts the size of the events denoted by *at least ten crows pecked King Edward.* Let's call sentences containing only upward-entailing quantifiers *upward-entailing sentences*, for convenience. Now, Krifka and Lasersohn have observed that allowing the events in the denotations of upward-entailing sentences to "grow" does not alter the truth value of the that sentence; they both therefore conclude that it is harmless to make the denotations of such sentences persistent. However, (5.43) demonstrates that allowing the denotations of such sentences to grow without bound potentially falsifies sentences which refer to or quantify over such events. Thus, even events in the denotations of upward-entailing sentences have a limit on their size, and this limit is imposed by the context.

In this thesis, I will assume that the denotations of upward-entailing and atomic sentences are sets of events which are as small as they can be. This conclusion has implications for the definition of *every* I proposed in Chapter 4:

(4.32) $[\![\text{every}]\!] = \lambda P \lambda E \lambda e[\forall x(P(x) \rightarrow \exists e'(e' \leq e \wedge E(x)(e')))]$

If I'm correct that sentences built out of upward-entailing determiners are minimal, then this definition of *every* ought to be minimal too, since it's upward-entailing in the appropriate way: while *no more than three boys* can lead to nonpersistent utterances in that we may find a fourth boy of which the VP is true if we keep looking, *every boy* is like *at least three* in that once its truth is validated, it cannot be invalidated by "growing" the event. Accordingly, I will augment the definition of *every* to reflect the minimality I've proposed:

(5.44) $MinPred = \lambda P \lambda x[P(x) \wedge \forall y((P(y) \wedge y \leq x) \rightarrow y = x)]$

(5.45) $[\![\text{every}]\!] =$
$\lambda P \lambda E[MinPred(\lambda e[\forall x(P(x) \rightarrow \exists e'(e' \leq e \wedge E(x)(e')))])]$

In other words, Davidsonian *every* is a function from CN denotations and Davidsonian VP denotations to sets of minimal events such that for all individuals in the CN denotation, there is some smaller event which consists of that individual performing the action denoted by the VP.

I readily admit that I have no formal account of how downward-entailing sentences come to refer to the events or situations they refer to. I can imagine all sorts of explanations. It's possible, for instance, that quantificational sentences like *no more than three crows pecked King Edward* do not denote sets of events the way atomic sentences do. In that case, what *it* refers to in (5.40) may not be an event, but rather some other element which is evoked by the quantification over events. This process might be parallel to the way individuals which are quantified over are summed together in discourses. So in (5.46), there is no single individual introduced in the first sentence which corresponds to the referent of *they* in the second sentence, yet reference is possible:

(5.46) Every student who gets an A will be rewarded. They will be honored at an assembly at the end of the school year.

Like the issue of existential closure and embedded events, the issue of the size of events raises important questions about the referential properties of sentences, questions which I do not have the space to address. Nevertheless, I think that it is clear that the facts of atomic event reference and modification clearly point to a minimal account of events, and in spite of Krifka's and Lasersohn's arguments to the contrary, nothing about the properties of quantified event descriptions challenges such a conclusion.

5.4 Conclusion

In this chapter, I have attempted to elucidate some of the subtler details of the Davidsonian program. In the process, we've identified one more property of our Davidsonian element: we've assumed that these elements can be absolutely atomic. This view is consistent with an interpretation of Davidsonian elements as primitive events, or as complex entities, but not as situations, as far as I can tell. We will continue to return to the issue of the type of the Davidsonian element as this thesis progresses.

Notes

[1]Krifka (p.c.) identifies existential closure as a first approximation to a "referential" account of event semantics; see Section 5.2.3 below.

[2]Krifka (p.c.) reminds me that properly, generic quantification is like any other (implicit) adverbial quantifier, in that it requires both a restrictor and nuclear scope. So (5.3) is evaluated relative to some (implicit) set of situations, and **G** is just a relation among sets like any other (non-Davidsonian) generalized quantifier. I doubt that this detail matters to the discussion to follow.

[3]As we will see in Section 5.3 below, this account of universal quantification is potentially subject to certain bizarre interpretations where Mary only sometimes opens the door when the bell rings, but e includes only those bell ringings for which Mary opens the door. At the very least, this interpretation is pragmatically odd; more likely, it is simply false. So somehow, we must ensure that these interpretations do not arise. What Kratzer (1989), Krifka (1992) and Lasersohn (1995) assume is that events are maximal in some sense; however, I think there is good reason to question that conclusion.

[4]This ought to follow from the properties of the denotations of these utterances, but to attempt such an analysis is beyond the scope of this thesis. For a related attempt, see Krifka (1992).

[5]Krifka (p.c.) claims that *whenever* is not a quantifier, but I am not convinced. See Footnote 12 in Chapter 2.

[6]Note that Portner's context update operator is not exactly compositional, since the assignment function g' is one of the indices at which S is evaluated. Oddly enough, there seems to be no requirement in Portner's system that the evaluation indices g, s in the initial clause of this definition actually be in C. There is a logical disconnect here which I cannot decipher.

[7]For Portner, the specifier of IP (that is, the subject position) is an appropriate landing site.

[8]The account of telicity and cumulativity for events in Krifka (1992) encounters a similar problem, since these properties are defined in terms of sets of events. See Chapter 7.

[9]This account of events as referrable discourse entities mirrors the DRT account of Hinrichs (1981) and Partee (1984).

[10]For related discussion, see Section 2.5 and Section 8.5.2.

[11]Portner's approach to this problem is somewhat confused, unfortunately. He assumes (without discussion, as far as I can tell) that events are minimal in the simplest case. However, the simplest case does not arise very often. For instance, Portner believes that the contrast in grammaticality between gerunds and event nominalizations in (i) is a consequence of a difference between the sizes of events corresponding to the subject:

(ia) *Eating that apple quickly took place on July 3.
(ib) The quick eating of that apple took place on July 3.

Portner proposes that the denotations of event nominalizations consist of maximal situations at some spatiotemporal location; however, he gives no arguments to support this contention, nor any suggestion why this contrast in acceptability might follow from the proposed contrast in denotations. Similarly, Portner assumes that situations in the denotation of sentences in the past tense are not minimal, again for no reason that I can see.

[12]Lasersohn (p.c.) suggests that we might get around this problem by building minimality into the meaning of adverbs, or the process of adverbial modification itself, thereby allowing verbal denotations to involve nonminimal events while preserving minimality in composition. However, since, as we will see below, minimality is crucial both in composition and in reference and binding (that is, from within the semantic constituent and from outside), there is no justification for countenancing nonminimality at all.

[13]For a more detailed discussion, see, for instance, Schuster (1986).

[14]This point is made briefly by Givon (1978) as well. For an extensive discussion of the pragmatic function of negation, see Horn (1989), especially Chapter 3.

Chapter 6

Neo-Davidsonian Semantics

In the previous chapters, I have elaborated a theory of Davidsonian semantics and demonstrated that it can be made consistent with classical concerns about the syntax/semantics interface. Yet the question remains: is this as far as we need to go? In Chapter 1, I contrasted four different semantic strategies:

(6.1) Classical:
$[\![\text{run}]\!] = \lambda x[run'(x)]$
$[\![\text{John runs}]\!] = run'(j)$

(6.2) Davidsonian:
$[\![\text{run}]\!] = \lambda x \lambda e[run'(x)(e)]$
$[\![[_{\text{V}} \text{ John run}]]\!] = \lambda e[run'(j)(e)]$
$[\![\text{John runs}]\!] = \exists e(run'(j)(e))$

(6.3) Lexical neo-Davidsonian:
$[\![\text{run}]\!] = \lambda x \lambda e[run'(e) \wedge \theta_{SU,run'}(x)(e)]$
$[\![[_{\text{V}} \text{ John run}]]\!] = \lambda e[run'(e) \wedge \theta_{SU,run'}(j)(e)]$
$[\![\text{John runs}]\!] = \exists e(run'(e) \wedge \theta_{SU,run'}(j)(e))$

(6.4) Compositional neo-Davidsonian:
$[\![\text{run}]\!] = \lambda e[run'(e)]$
$[\![[_{\text{V}} \text{ John run}]]\!] = \lambda e[run'(e) \wedge \theta_{SU,run'}(j)(e)]$
$[\![\text{John runs}]\!] = \exists e(run'(e) \wedge \theta_{SU,run'}(j)(e))$

In virtue of the arguments presented in Chapter 2, I am convinced that the classical strategy ought to be discarded. What remains is for us to choose among the three remaining event-based strategies. In discussing these three accounts, I pointed out that the Davidsonian and the lexical neo-Davidsonian approaches are identical from the point of view of compositional semantics, since they both offer an order-based model of argument saturation, with an extra argument for the Davidsonian element. Therefore, I believe that considerations of compositional semantics will not distinguish between these two accounts. However, the compositional neo-Davidsonian account is genuinely different from these two order-based accounts, and thus the question to be answered is: which one should we choose?

In the chapters to follow, I will defend the more conservative, order-based strategy against the compositional neo-Davidsonian strategy. Before I present this defense, however, I wish to provide some background and details on the general neo-Davidsonian program and how it relates to the syntax/semantics interface. In particular, I will show that both the neo-Davidsonian strategies exemplified above can be at least plausibly defended. As an example, I will develop a fairly detailed compositional neo-Davidsonian account which will allow us to compare the two major compositional strategies.

6.1 Preliminaries

Consider a rather small eventuality, one in which LaToya writes a song and nothing else happens. As the writer of the song, LaToya is sentient, volitional, and the causer of the resulting state of the song coming into existence. As the thing written, the song comes into existence and is causally affected by LaToya. How do we understand that these properties hold of the participants based on our interpretation of the sentence *LaToya wrote a song*? That is, how do we identify the surface subject of active *write* with the writer and the surface direct object with the thing written? More precisely, how do we link argument positions with participants?

The classical and Davidsonian approaches provide one answer: the order of semantic arguments parallels the order of syntactic arguments, and the question of how to link argument positions with participants is held irrelevant to issues of semantic composition. However, the lexical neo-Davidsonian approach shows that not all who have access to order-based composition choose to ignore this concern, and frameworks which do not rely on ordered arguments cannot avoid it.

The most common approach to this issue involves *thematic roles*. Thematic roles have a long and well-established history in generative grammar, dating back at least to Fillmore (1968) and Gruber (1965).[1] The idea is that there is a fairly short list of types of participation to which a given constituent might be assigned. The list which follows is taken from Gruber (1965):

- *Agent*: an NP expressing will toward the action: *[$_{Agent}$ The man] threw the ball.*
- *Theme*: for verbs of motion, the object undergoing the motion: *[$_{Theme}$ The rock] moved.* For verbs of location, the thing which is located: *[$_{Theme}$ The rock] stood in the corner.*
- *Location*: the NP or PP expressing location: *John stayed [$_{Location}$ in the room].*
- *Source*: the initial position of the Theme: *John walked [$_{Source}$ from France] to Spain.*
- *Goal*: the final destination of the Theme: *John walked from France [$_{Goal}$ to Spain].*

Although the details of accounts of thematic roles have changed notably over the years (see especially the work of Jackendoff (1972; 1983)), the goal of the enterprise has remained the same: to find a small set of basic roles which can be used in grammar.

The list of phenomena for which a thematic explanation has been proposed is fairly long; cf. Dowty (1991) for a representative summary and critique. The only use of thematic roles which I will examine in this dissertation is their function as "links" between participants and events in semantic composition. I will call this function *argument indexing*. Thematic roles have been imported into model-theoretic semantics for this purpose by Chierchia (1984), Carlson (1984), Dowty (1989), Parsons (1990), Krifka (1989; 1992), and Schein (1994), at least. However, very few of these accounts are as explicit as would be required to examine their consequences for the syntax/semantics interface. Carlson (1984), for instance, is more of a discussion than anything else; Parsons (1990) constructs a fragment, but his syntax is quite *ad hoc* and he explicitly avoids discussing quantification or coordination; and Schein (1994) doesn't even attempt to construct a syntax/semantics map.

In the sections to follow, I will examine the model-theoretic properties of thematic roles in detail, following Dowty (1989). As an illustration, I will discuss and revise the account of Krifka (1989; 1992), which is the most explicit account of thematic roles at the syntax/semantics interface.

6.2 Argument indexing and thematic role ontology

How important is it to find a small set of general thematic roles? When I introduced elements like $\theta_{SU,run'}$ in Chapter 1, I noted that I intended to remain agnostic about whether these elements correspond to broad thematic roles like $Agent$ or $Theme$ or to narrow thematic roles like $runner'$. That is, in employing such notation I am in no way ruling out the possibility that $\theta_{SU,run'}$ might be identical to $\theta_{SU,eat'}$, $\theta_{SU,grab'}$, etc.; in such a case, we might choose $Agent$ as a "better" name for this relation. In this section, I will explore the relationship between the ontological properties of thematic roles, the size of the set of thematic roles, and the goals of the two neo-Davidsonian semantic strategies.

6.2.1 An unsatisfying account of thematic roles

Compare once again the lexical and compositional neo-Davidsonian accounts:

(6.3) Lexical neo-Davidsonian:
$[\![\text{run}]\!] = \lambda x \lambda e[run'(e) \wedge \theta_{SU,run'}(x)(e)]$
$[\![[_{\text{V}} \text{ John run}]]\!] = \lambda e[run'(e) \wedge \theta_{SU,run'}(j)(e)]$
$[\![\text{John runs}]\!] = \exists e(run'(e) \wedge \theta_{SU,run'}(j)(e))$

(6.4) Compositional neo-Davidsonian:
$[\![\text{run}]\!] = \lambda e[run'(e)]$
$[\![[_{\text{V}} \text{ John run}]]\!] = \lambda e[run'(e) \wedge \theta_{SU,run'}(j)(e)]$
$[\![\text{John runs}]\!] = \exists e(run'(e) \wedge \theta_{SU,run'}(j)(e))$

If we assume that the logical expressions presented here are simply ways of writing down denotations, then elements like $\theta_{SU,run'}$ must name actual relations and not be uninterpreted symbols. This requirement is actually fairly easy to meet; the issue is how insightful the implementation is.

The discussion will be clearer if I illustrate the problem with transitive verbs. Let us assume, for instance, that we are given a relation $writer'$ which is specific to and complete with respect to writing events; that is,

(6.5) $\Box\forall e((\exists x(writer'(x)(e))) \leftrightarrow write'(e))$

Furthermore, let us assume that any element related to any such e by $writer'$ is the writer in e. Let us also assume that the filler of this role is unique:[2]

(6.6) $\Box\forall x\forall y\forall e((writer'(x)(e) \wedge writer'(y)(e)) \rightarrow x = y)$

Finally, let us assume that the relation $writee'$ is also appropriately defined, and in general, let us assume that every verbal event predicate δ is assigned a set of relations θ which associate elements of δ with the appropriate and intended participants in a parallel way.

What I've stipulated so far is a set of relations which Dowty (1989) calls *individual thematic roles*. I have not defined these relations; rather, I have simply identified their properties and required them to exist in the appropriate way. In other words, I've presented what is most likely the least insightful account of thematic roles which conforms to the requirement that thematic roles have interpretations. The question now becomes: what can and can't we do with such a definition, and what must we add in order to do more?

It turns out that this account of individual thematic roles adequately supports both neo-Davidsonian semantic strategies, as well as some notion of more general thematic roles. Neither approach will be satisfying, however, and as we develop them, we will see why. First, let's identify $\theta_{SU,write'}$ and $\theta_{DO,write'}$ with $writer'$ and $writee'$ and see what we get:

(6.7) Lexical neo-Davidsonian:

$[\![\text{write}]\!] =$
$\lambda y \lambda x \lambda e[write'(e) \wedge writer'(x)(e) \wedge writee'(y)(e)]$
$[\![[_{V/_L NP}\ \text{write song}_1]]\!] =$
$\lambda x \lambda e[write'(e) \wedge writer'(x)(e) \wedge writee'(s_1)(e)]$
$[\![[_V\ \text{LaToya write song}_1]]\!] =$
$\lambda e[write'(e) \wedge writer'(l)(e) \wedge writee'(s_1)(e)]$
$[\![\text{LaToya writes song}_1]\!] =$
$\exists e(write'(e) \wedge writer'(l)(e) \wedge writee'(s_1)(e))$

(6.8) Compositional neo-Davidsonian:
$[\![\text{write}]\!] = \lambda e[write'(e)]$
$[\![[_{V/_{L}NP}\ \text{write song}_1]]\!] =$
$\lambda e[write'(e) \wedge writee'(s_1)(e)]$
$[\![[_{V}\ \text{LaToya write song}_1]]\!] =$
$\lambda e[write'(e) \wedge writer'(l)(e) \wedge writee'(s_1)(e)]$
$[\![\text{LaToya writes song}_1]\!] =$
$\exists e(write'(e) \wedge writer'(l)(e) \wedge writee'(s_1)(e))$

In each case, the final denotation asserts the existence of an event which is a writing event in which LaToya is the unique writer and song$_1$ the unique thing written. In order to employ more general thematic roles, we define *Agent* and *Patient* as disjunctions of individual roles, following Dowty (1989):

(6.9a) $Agent = \lambda x \lambda e[writer'(x)(e) \vee hitter'(x)(e) \vee \ldots]$
(6.9b) $Patient = \lambda x \lambda e[writee'(x)(e) \vee hittee'(x)(e) \vee \ldots]$

If we now identify $\theta_{SU,write'}$ and $\theta_{DO,write'}$ with $Agent$ and $Patient$, we get the following

(6.10) $[\![\text{LaToya writes song}_1]\!] =$
$\exists e(write'(e) \wedge Agent(l)(e) \wedge Patient(s_1)(e))$

If we make the assumption that $write'$, hit', etc., are mutually disjoint in the necessary ways,[3] we can infer from the interpretation of *LaToya writes song*$_1$ that LaToya is the writer in e, because e is a writing event and all of the disjuncts in the definition of $Agent$ are specific to their verbal predicates, as required in (6.6). So if we know that e is a writing event, we know that anything $Agent$-related to that event must be the $writer'$-related to it. So both individual thematic roles and more general "cover" roles can be defined coherently.

6.2.2 *What do roles mean?*

But there's something missing here. While the account of thematic roles I've just given seems to cover both indexing and general roles, in each case there's nothing about the inherent properties of the events and roles themselves which contributes to the account. The $writer'$ relation is just some relation between writing events and individuals which happens to have the required properties. But there are crucial linguistic facts which are left unpredicted. For instance, why is it that $writer'$ corresponds to the active subject of *write* instead of the direct object? Why does $Agent$ group together $writer'$ and $hitter'$ instead of $writer'$ and $hittee'$?

The intuitive answer, of course, has to do with what these roles *mean*. For instance, what properties does any writer in a writing event have which distinguishes such a participant from any element written? We might hope that a notion of such properties might allow us both to describe broad generalizations about the correspondence between thematic role fillers and surface argument positions and to define broad thematic roles if possible. In this section, I will attempt to give some content to the definition of individual thematic roles. My point of departure will be Dowty (1989).

When LaToya writes a song, there are a set of statements that we can make about LaToya based on our knowledge of the way she participates in the writing event in question, and we've seen some of these already: she is sentient, volitional, and a causer, for example. In some sense, then, the role of writer is defined by the set of entailments which are true of any individual by virtue of participating in a writing event in this particular way. For Dowty, these individual thematic roles are defined in terms of argument positions of (non-Davidsonian) predicates. Given some n-ary predicate δ and a particular argument x_i, the *individual thematic role* $\alpha_{\delta,i}$ is that set of properties which necessarily hold of any filler of the i-th argument position:

(6.11) $\alpha_{\delta,i} = \{P|\Box[\delta(x_1,\ldots,x_i,\ldots,x_n) \rightarrow P(x_i)]\}$

There is a basic problem with this definition. If we intend to constrain the neo-Davidsonian account in any useful way, we need to use the properties of thematic roles to determine which participant ought to be the subject, which participant ought to be the object, etc. In other words, we want thematic roles to determine argument order. But what Dowty does is define thematic roles in terms of a *previously defined* argument order. In other words, Dowty's definition assumes what we're trying to predict.

Furthermore, we can't reverse Dowty's definition as it stands. The properties which LaToya has in virtue of participating as the writer in a writing event are not properties which LaToya has *in general*; being volitional and being a causer are properties that LaToya bears *in the context of the writing event specifically*. The dependency on the event in question is captured in Dowty's definition by the direction of implication;

however, the fact that the implication encodes this dependency means that we can never reverse it. While it is always true that if LaToya is a writer, she is also a causer, the converse is not universally true.

I think both these problems can be solved by creating a Davidsonian version of Dowty's account. By defining thematic roles in terms of relations between individuals and events instead of properties of individuals, we have a chance of capturing the event context which may allow us to produce a version of Dowty's definition in which the arrow of implication can be reversed.

So what relations between individuals and events should we consider? In every writing event, there is a volitional participant, and we know that volition is commonly mentioned in discussions of thematic roles; on the other hand, in every harvesting event, there is a participant which is a plant, and this property is never mentioned in discussions of thematic roles. I will not attempt to answer this question in this thesis, since many others (for instance, Dowty (1991), Gawron (1988)) have made considerable progress in this area; I will assume a set of relations $\mathcal{R}_{map}$ which is the smallest set of relations which includes all those relations which bear on the mapping between participants and syntactic arguments. This set will include things like $causally\!-\!participates\!-\!in'$, $acts\!-\!volitionally\!-\!in'$, etc.

A faithful Davidsonian reinterpretation of Dowty would take thematic roles will be sets of relations. However, such objects are the wrong type of objects to serve as thematic roles in the preceding discussion; the objects in question are relations, not sets of relations. So we will begin by defining an *individual thematic role set* α_δ of any event predicate δ as a subset of $\mathcal{R}_{map}$. In particular, each role set will be some nonempty subset of $\mathcal{R}_{map}$ each of whose members mutually entail each other for every individual they relate to any element of δ:

$$(6.12)\Theta_\delta = \{\alpha \mid \alpha \subseteq \mathcal{R}_{map} \wedge \alpha \neq \emptyset \wedge \\ \forall R(R \in \alpha \rightarrow \\ \forall R'((R' \in \mathcal{R}_{map} \wedge \exists x \exists e(\delta(e) \wedge R(x)(e)) \wedge \\ \Box \forall x \forall e(\delta(e) \rightarrow (R(x)(e) \leftrightarrow R'(x)(e)))) \rightarrow \\ R' \in \alpha))\}$$

The best way to digest this definition is via an example. Consider the event predicate $write'$. Among the elements of of $\mathcal{R}_{write'}$ are relations like $acts\!-\!volitionally\!-\!in'$, $comes\!-\!into\!-\!existence\!-\!due\!-\!to$, $causally\!-\!participates\!-\!in'$, etc. The set $\Theta_{write'}$ is some partition of a subset of $\mathcal{R}_{map}$.[4] Consider an element α_i of $\Theta_{write'}$, and assume that $acts\text{−}volitionally\text{−}in' \in \alpha_i$. Now, consider another relation R', such as $causally\text{−}participates\text{−}in'$. Is R' in α_i as well? According to our definition, these two relations are in the same individual thematic role set iff it is necessarily the case that for all writing events, any individual which acts volitionally in that event also causally participates in it and vice versa. Since this is true for writing events, these two relations will be in the same thematic role set in any appropriate partition of $\Theta_{write'}$; $comes\text{−}into\text{−}existence\text{−}due\text{−}to$, on the other hand, does not mutually entail either of these relations in the context of $write'$, and thus must be in a different thematic role set.

Now, these objects are not quite individual thematic roles yet. Individual thematic roles, as used in the previous section, are relations, not sets of relations. There is an obvious equivalence to be drawn, of course; individual thematic roles are previously conceived are the intersection of these sets of relations we've just defined:

(6.13) For any $\alpha_{\delta,i} \in \Theta_\delta$, $\theta_{\delta,i} = \bigcap \alpha_{\delta,i}$

The objects $\theta_{\delta,i}$ are of the appropriate type to be used in the preceding sections.

Now, let's try to generalize these individual roles in some way more informative than the account in (6.9). In particular, we wish to base this generalization on the definitions of these individual thematic role sets $\alpha_{\delta,i}$. Dowty proposes that we might define a *thematic role type* τ as the intersection of many individual roles, the intuition being that these more general roles ought to be all and only the entailments held in common among its instances. Now, only some of these role types will be interesting; these will be the ones such as (we hope) *Agent*, *Source* etc. Dowty calls this distinguished subset of role types the set of *L-thematic role types*, or simply *thematic roles*.

The advantage of beginning with a set of relevant relations $\mathcal{R}_{map}$ manifests itself in examining Dowty's account of generalization. In Dowty's account, the set of properties in a thematic role is that set which is necessarily entailed by any individual occupying a particular place in a tuple. But this means that if P is in this set, so is $\lambda x[P(x) \vee Q(x)]$ for any property Q. This leads to some odd possibilities. Consider the following two individual thematic roles:

(6.14a) $\alpha_{kill',DO} = \{P, \lambda x[P(x) \vee Q(x)], \ldots\}$

(6.14b) $\alpha_{eat',SU} = \{Q, \lambda x[P(x) \vee Q(x)], \ldots\}$

Now, these two individual thematic roles have an intersection, which leads to a very strange *L*-thematic role type:

(6.15) $\theta_{odd} = \{\lambda x[P(x) \vee Q(x)], \ldots\}$

That is, we've managed to construct a thematic role which corresponds to the generalization of the object of *kill* and the subject of *eat*, which is not a thematic role which serves any sort of useful purpose. If we restrict the properties/relations we're able to consider, on the other hand, this problem does not arise. So while we might not be able to determine the precise members of $\mathcal{R}_{map}$, we know that assuming such a set gives us a noncircular way of defining individual thematic roles, and hopefully, more general roles as well.

6.2.3 Thematic roles and argument indexing

But determining whether we get roles that we don't want is only one question we can ask about the generalization operation. There are two others which are far more important. First, do we get the general roles we *do* want? And second, do we really want them?

With respect to the matters at hand, I believe the answers to these two questions are no and no, respectively. In the current discussion, we are concerned with two distinct problems: first, using thematic roles to connect event individuals with participants in semantic interpretations, and second, using them to determine the correspondence between participants and syntactic argument positions. I will take up each of these matters in turn.

For connecting events and participants in meanings, I will skip the first question, because the answer to the second is so clear. Assume that the definition of thematic roles provided in (6.12) is adequate. Then we know that for any event predicate δ, we can determine its set of thematic roles, and that these roles are model-theoretically coherent. In the lexical neo-Davidsonian case, then, we have model-theoretically coherent objects which can be used within lexical definitions to link up events and participants. In the compositional neo-Davidsonian case, since we have a method of deriving the set of individual thematic roles for any event predicate, we can provide the compositional semantics with the array of roles it needs to relate the appropriate events and participants. In general, then, there's no discernible need for any thematic role abstractions at all in this case.

For determining the correspondence between participants and syntactic arguments, the answers are somewhat less clear. Numerous attempts have been made to define general thematic roles in terms of necessary and sufficient conditions, including the intersection strategy optimistically outlined above. However, in later work (Dowty, 1991), Dowty argues that this enterprise is extremely unlikely to succeed at this task. He argues – convincingly, I think – that the properties which contribute to argument mapping are measured in *relative* terms. In Dowty's alternative, there is a set of *proto-Agent* properties which are characteristic of subjects, and a set of *proto-Patient* properties which are characteristic of objects. The subject of any predicate is determined by which argument has the most proto-Agent properties, and the object is determined by which argument has the most proto-Patient properties. So while these sets of properties might be disjoint (and Dowty's are), bearing proto-Agent properties in the context of an event does not guarantee a participant of being the subject, since another participant might bear more.

If Dowty is right, the only property which *defines* the *Agent* role, for instance, is the property of bearing the largest number of proto-Agent properties in a given event. On the other hand, this property is not one of the properties – causation, volition, etc. – which is typically considered in the process of strictly defining general thematic roles. At this point, we must ask whether we actually need these general roles, and I think the answer is no. It is true that we need some principle which will allow us to determine the correspondence between participants and argument positions, but there is no reason to believe that this principle must be embodied in some categorization of broader roles.

For instance, let us return to our global relevant relation set $\mathcal{R}_{map}$. A subset of this set, call it $\mathcal{R}_{Agent}$, corresponds to Dowty's proto-Agent properties; similarly for proto-Patient. Given an array of thematic roles Θ_δ, we can easily identify which role corresponds to the subject by finding out which role has the largest intersection with $\mathcal{R}_{Agent}$; we can determine the object in a parallel way. So we can implement Dowty's (1991) account straightforwardly, given some notion of "relevant" properties and a coherent notion of individual thematic roles. No generalizations are required.[5]

I have argued in this section that individual thematic roles can be coherently defined independent of ordered arguments, and can be used both to connect events and participants in semantic representations and to determine argument mappings, without needing to generalize to general thematic roles. Of course, if it turns out that we can generalize, nothing that I've said is incompatible with using these general roles where possible; however, my only goal in this section has been to demonstrate that the model-theoretic tools we have are sufficient to make a neo-Davidsonian strategy at least plausible.

6.3 Thematic roles in sentence semantics

In this section, I will present the details of the most explicit compositional neo-Davidsonian proposal that I know of, that of Krifka (1992). I will examine the shortcomings of this account, and provide an alternative.

6.3.1 General properties of neo-Davidsonian composition

Before we turn to Krifka's account and its alternatives, let's consider what the general properties of compositional neo-Davidsonian strategies are. We begin with (6.4), repeated here:

(6.4) Compositional neo-Davidsonian:
$[\![\text{run}]\!] = \lambda e[run'(e)]$
$[\![[_{\text{V}} \text{ John run}]]\!] = \lambda e[run'(e) \wedge \theta_{SU,run'}(j)(e)]$
$[\![\text{John runs}]\!] = \exists e(run'(e) \wedge \theta_{SU,run'}(j)(e))$

Notice that the denotation of *run* is a set of events, as is the denotation of *John runs* before existential closure. Since the "unsaturated" verb and the "saturated" sentence have the same semantic type, we cannot model argument absorption as function application and a reduction in valence, unlike in the other three strategies. Furthermore, while the thematic role $\theta_{SU,run'}$ associated with *run* can be computed from the neo-Davidsonian denotation of *run*, as illustrated above, it doesn't explicitly provide this role as part of its denotation. These differences have significant consequences for the syntax/semantics map and for argument absorption itself. I will take up each of these issues in turn.

For example, to what degree have we abandoned the type correspondence between syntax and semantics? Let's begin with a revised type assignment based on Krifka's account of existential closure from (5.2):

(6.16a) $TYP(\mathrm{NP}) = e$
(6.16b) $TYP(\mathrm{V}) = \langle\epsilon, t\rangle$
(6.16c) $TYP(\mathrm{S}) = t$
(6.16d) $TYP(\mathrm{CN}) = \langle e, t\rangle$
(6.16e) $\forall\mathrm{A}\forall\mathrm{B}(TYP(\mathrm{A}/_{\mathrm{L}}\mathrm{B}) = TYP(\mathrm{A}/_{\mathrm{R}}\mathrm{B}) = \langle TYP(\mathrm{B}), TYP(\mathrm{A})\rangle)$

This type assignment preserves the strict correspondence between syntactic and semantic valence. The compositional neo-Davidsonian strategy, however, does not. Every verbal predicate, whether it be a transitive verb, a VP, or a V, denotes a set of events. Thus, by its very nature, the syntax/semantics map in a compositional neo-Davidsonian approach is somewhat weaker than in the classical account.

However, such an approach does not totally abandon type correspondences. In the type assignment in (6.16), we build up type assignments recursively for all complex categories. To a large extent, we can do the same in the neo-Davidsonian approach; it will simply no longer be the case that the semantic type of *all* complex categories will be determined recursively. Let's say we change our initial assumptions so that the type of V, V/NP, (V/NP)/NP, etc., is $\langle\epsilon, t\rangle$:

(6.17a) $TYP(\mathrm{NP}) = e$
(6.17b) $TYP(\mathrm{S}) = t$
(6.17c) $TYP(\mathrm{CN}) = \langle e, t\rangle$
(6.17d) $TYP(\mathrm{V}) = \langle\epsilon, t\rangle$
(6.17e) $TYP(\mathrm{V/NP}) = \langle\epsilon, t\rangle$
$TYP((\mathrm{V/NP})/\mathrm{NP}) = \langle\epsilon, t\rangle$
...
(6.17f) Otherwise,
$\forall\mathrm{A}\forall\mathrm{B}(TYP(\mathrm{A}/_{\mathrm{L}}\mathrm{B}) = TYP(\mathrm{A}/_{\mathrm{R}}\mathrm{B}) = \langle TYP(\mathrm{B}), TYP(\mathrm{A})\rangle)$

The clause (6.17e) is intended to cover all syntactic arguments of V.[6] The "otherwise" clause (6.17f) is intended to cover all complex cases which do not correspond to a projection of V. For instance, the semantic type of a VP modifier, of category (V/NP)/(V/NP), is computed recursively. In other words, once we state our changed assumption, it ought to still be possible to recursively construct type assignments for complex categories in the default case.

But how do these verbal projections take arguments? In particular, where does the thematic role come from? I alluded to this problem in Chapter 1. I am aware of at least three possibilities:

- The semantics of the verb determines some set of thematic roles, and the correspondence between these roles and particular argument positions is provided by some global principle, such as a universal hierarchy of thematic roles. This approach is exemplified in Fillmore (1968), Jackendoff (1972), Kiparsky (1987), and Grimshaw (1990), among others.

- The verbal constituent employs syntactic features to trigger the use of particular thematic roles in combining with its arguments. This is the approach of Krifka (1992), to which I will discuss in detail in Section 6.3.2 below.

- The semantic dimension of the verbal constituent is a structure constructed out of the verbal event predicate and a sequence of thematic roles. This is the neo-Davidsonian account which I will develop in detail in Section 6.3.3 below.

What these three accounts share is that the semantic dimension of the verbal constituent somehow selects the relevant thematic role. In categorial terms, if we ignore generalized quantifiers for a moment, at every argument position, there are three relevant "ingredients":

- a syntactic functor of category A/B, which denotes a set of events P;

- a constituent of category B, which denotes an individual a;

- and a thematic role θ, which represents the relationship between any filler of this particular argument position and any event in P.

Assume that we are somehow given θ, perhaps by one of the strategies I just described. We can describe the denotation P' of the resulting constituent of category A with the "recipe" in (6.18):[7]

(6.18) $P' = \lambda e[P(e) \wedge \theta(a)(e)]$

For instance, in order to get from *runs* to *John runs* in (6.4), we somehow compute from the constituent *runs* the thematic role $\theta_{SU,run'}$. Given this thematic role, we can see that the denotation of *John runs* given in (6.4) is simply the result of existentially closing the output of the recipe in (6.18).

Now, (6.18) is not a grammatical rule, of course; it's merely a description of what the output of the rule we're looking for will look like. In the sections to follow, I will present two different compositional neo-Davidsonian strategies, each with a different version of this rule.

6.3.2 Krifka's account

Krifka has presented two different accounts of thematic roles: one which links events and individuals via free variables corresponding to participants (cf. Krifka (1989)), and another which uses syntactic features to select the proper thematic roles (cf. Krifka (1992)). It is this latter account which I will focus on.

The features which Krifka uses are thematic role features, one for each (broad) thematic role. Krifka proposes that determiners encompass the link between participant and event, while syntactically encoding the thematic role which it uses. We illustrate Krifka's strategy here with his derivation of the VP *drink some water*:[8]

(6.19)

$$\dfrac{\dfrac{\text{some}}{\text{NP}[\textit{patient}]/\text{N},\ \lambda P \lambda Q \lambda e[\exists x(P(x) \wedge PAT(e,x) \wedge Q(e))]} \quad \dfrac{\text{water}}{\text{N},\ water'}}{\textbf{FA}\text{: NP}[\textit{patient}],\ \lambda Q \lambda e[\exists x(water'(x) \wedge PAT(e,x) \wedge Q(e))]}$$

(6.20)

$$\dfrac{\dfrac{\text{drink}}{(\text{V/NP}[\textit{agent}])/\text{NP}[\textit{patient}],\ drink'} \quad \dfrac{\text{some water}}{\text{NP}[\textit{patient}],\ \lambda Q \lambda e[\exists x(water'(x) \wedge PAT(e,x) \wedge Q(e))]}}{\textbf{FA}\text{: V/NP}[\textit{agent}],\ \lambda e[\exists x(water'(x) \wedge PAT(e,x) \wedge drink'(e))]}$$

I think this account has a number of problems. First, consider the way he incorporates thematic roles into his account. Krifka makes explicit reference to a small set of thematic roles, which are incorporated into determiner meanings. So a determiner like *some* is going to be multiply ambiguous, one meaning for each thematic role. In addition, the null determiners found with mass nouns and bare and generic plurals must also be ambiguous among these roles, as must be whatever element links proper nouns and verbs:[9]

(6.21)

$$
\dfrac{\dfrac{\dfrac{\text{LaToya}}{\text{NP},\ l} \quad \dfrac{}{\text{NP}[agent]/\text{NP},\ \lambda x\lambda Q\lambda e[AGENT(e,x) \wedge Q(e)]}}{\textbf{FA}\text{: NP}[agent],\ \lambda Q\lambda e[AGENT(e,l) \wedge Q(e)]} \quad \dfrac{\text{drank}}{\text{V/NP}[agent],\ drink'}}{\textbf{FA}\text{: V, } \lambda e[AGENT(e,l) \wedge drink'(e)]}
$$

These determiners must be ambiguous both syntactically and semantically, since the syntactic category must encode the thematic role employed. As the number of roles grows, the number of syntactic thematic role features grows, as does the range of ambiguity. In particular, if the number of thematic roles cannot be limited to a small, predefined set – or, in the worst case, if we must use individual thematic roles – this system may become unwieldy. One might propose a lexical rule which generates these forms automatically for any determiner, but this solution is not feasible in the case of individual thematic roles, unless we wish to assume that the syntactic feature set is arbitrarily large as well.

Second, notice that Krifka's type for NP is not e; rather, it is the type of event modifiers, $\langle\langle\epsilon,t\rangle,\langle\epsilon,t\rangle\rangle$. This introduces some odd perturbations in Krifka's syntax/semantics map. The grammar rule which combines determiners with CNs in (6.20) and (6.21) conforms to the rule in (6.22):[10]

(6.22) $\text{FA}(\langle \text{A/B}, m_{1,TYP(\text{A/B})}\rangle, \langle \text{B}, m_{2,TYP(\text{B})}\rangle) = \langle \text{A}, m_1(m_2)\rangle$

That is, the functor in the syntax is the functor in the semantics. This correspondence is quite typical of a strong syntax/semantics map, and in fact describes Function Application in all of the order-based accounts I've described so far. However, this correspondence does *not* hold of the process which, for Krifka, combines verbs with their arguments. The process of combining a verb with its object in (6.20), for instance, conforms to the rule in (6.23):

(6.23) $\text{FA}(\langle \text{A/B}, m_{1,TYP(\text{A/B})}\rangle, \langle \text{B}, m_{2,TYP(\text{B})}\rangle) = \langle \text{A}, m_2(m_1)\rangle$

The functor in the semantics is the argument in the syntax, and vice versa. The reason for this mismatch, of course, is that verbs cannot be semantic functors in compositional neo-Davidsonian strategies. NPs, by virtue of being functors, are able to supply the thematic role required to link the argument filler with the event in question, and if the verb were the functor, it would have to supply the thematic role. But that would amount to a lexical neo-Davidsonian account, and more to the point, the hypothesis that all verbal projections denote objects of the same type would have to be abandoned.

Nevertheless, this mismatch violates the generalization that a constituent which is a functor in one dimension is a functor in all of them. Fortunately, while there is a sound motivation for making the NP the semantic functor, there is no particular reason to make it the syntactic argument. So if we model arguments as syntactic functors over their predicates, we no longer find ourselves with this mismatch:

(6.24)

$$\dfrac{\dfrac{\dfrac{\text{LaToya}}{\text{NP}, \; l} \qquad \dfrac{}{(\text{V/(V/NP}[agent]))\text{/NP}, \; \lambda x \lambda Q \lambda e[AGENT(e,x) \wedge Q(e)]}}{\textbf{FA}: \text{V/(V/NP}[agent]), \; \lambda Q \lambda e[AGENT(e,l) \wedge Q(e)]} \qquad \dfrac{\text{drank}}{\text{V/NP}[agent], \; drink'}}{\textbf{FA}: \text{V}, \; \lambda e[AGENT(e,l) \wedge drink'(e)]}$$

This modification has a second advantage. In addition to enforcing a parallel between syntactic and semantic functors and arguments, it yields an analysis which conforms better to the principles of limited recursive type assignment illustrated in (6.17). For instance, in (6.21) the category NP is associated with the type $\langle\langle\epsilon,t\rangle,\langle\epsilon,t\rangle\rangle$, which corresponds to no possible NP type we've seen so far. However, the account in (6.24) conforms to the following recursive type assignment:

(6.25a) $TYP(\text{NP}) = e$
(6.25b) $TYP(\text{S}) = t$
(6.25c) $TYP(\text{CN}) = \langle e,t\rangle$
(6.25d) $TYP(\text{V}) = \langle\epsilon,t\rangle$
(6.25e) $TYP(\text{V/NP}[\theta_i]) = \langle\epsilon,t\rangle$
$TYP((\text{V/NP}[\theta_i])\text{/NP}[\theta_i]) = \langle\epsilon,t\rangle$
...

(6.25f) Otherwise,
$$\forall A \forall B(TYP(A/_L B) = TYP(A/_R B) = \langle TYP(B), TYP(A)\rangle)$$

In this type assignment, the null type-shifter is a function from NPs (that is, type e) to functions from VP-type denotations (that is, type $\langle \epsilon, t\rangle$) to V denotations (that is, sentence denotations before existential closure, also of type $\langle \epsilon, t\rangle$). This type assignment matches exactly the interpretation assigned to the null type-shifter in (6.24).

However, this solution is not without its problems. One of the advantages of the rule of Argument Raising presented in Chapter 4 is that we did not have to postulate a categorial ambiguity for generalized quantifiers. In the classical and Davidsonian accounts, generalized quantifiers reduce the valence of VPs, turning them into Vs or Ss:

(6.26) $V/_R(V/_L NP)$

This is the basic type of generalized quantifiers; what we typically think of as the grammatical argument is "born" in a raised type, so that it becomes the semantic and syntactic functor. But how do generalized quantifiers occupy other argument positions? We saw in Chapter 4 that Argument Raising converts the syntactic and semantic type of the verb so that it takes generalized quantifiers as arguments. If the direction of function application were reversed – that is, if an object generalized quantifier were the functor and the transitive verb the argument, as it is in subject position – the generalized quantifier would have to bear a category which reduces the valence of transitive verbs to VPs:

(6.27) $(V/_L NP)/_L((V/_L NP)/_R NP)$

That is, generalized quantifiers would require a different syntactic category (and semantic type) for each argument position in which they could appear (subject, object, etc.). This ambiguity would presumably be reflected in the category assigned to determiners, and the analysis suggested in (6.24) is an instance of this problem. Undoubtedly, Argument Raising induces a sort of ambiguity in the syntactic and semantic type of verbs as well; however, the difference is that, in the case of Argument Raising, the entire ambiguity can be generated by rule, but because determiners are "born" at an inherently raised type, representing the ambiguity as an ambiguity in generalized quantifiers is necessarily a listed lexical ambiguity.

Finally, coordination seems to be a considerable problem at some levels. In particular, it is not at all clear how to handle VP coordination in Krifka's account. For instance, consider how Krifka might analyze (6.28):

(6.28) Michael entertained in Vegas and was reviewed favorably.

(6.29) $\langle$"entertain", V/NP[*agent*], $entertain'\rangle$

(6.30) $\langle$"be reviewed", V/NP[*patient*], $review'\rangle$

The subject NP *Michael* bears two different thematic roles, one to *entertain* and another to *be reviewed.* I will assume for the sake of discussion that *entertain* assigns the *Agent* role to its active subject, and *review* assigns the *Patient* role to its Passive subject, but the precise assignments do not matter; rather, all that is important is that they differ.

The first problem to be overcome is that the syntactic categories of *entertain* and *be reviewed* differ, and standard accounts of coordination demand identity of categories. However, it is unusual but not unheard of to find coordinations of unlike categories, as in (6.31):

(6.31) LaToya is a musician and proud of it. (NP and AP)

The coordination of unlikes has been addressed in a range of work; in particular, in Bayer (1996) I describe an account of the coordination of unlike categories in Categorial Grammar which specifies the syntax of such coordinations. The worse problem is: once we coordinate these VPs, how can they combine appropriately with whatever the subject is? This problem turns out to be insurmountable. We will continue to take the semantics of *and* in the Davidsonian case to be the sum conjunction of Lasersohn described in Section 3.6:

(6.32) $[\![\text{entertain and be reviewed}]\!] =$
$$\lambda e[\exists e'\exists e''(entertain'(e') \wedge review'(e'') \wedge e = e' + e'')]$$

Now, because we're encoding the thematic roles in determiners and NP type shifters, whatever shifter applies to *Michael* will have to specify somehow that Michael is both an *Agent* and a *Patient*. But which role corresponds to which subpart of the event? If we maintain principles of strict compositionality, requiring that subsequent semantic rules not "look inside" semantic constituents already built, it seems that maintaining the appropriate correspondence is impossible. This problem is an intricate one, and requires a great deal more discussion, which I will postpone until Appendix A. However, I think my overall point is clear: as an account of the neo-Davidsonian syntax/semantics map, Krifka's account has a number of nagging problems.

6.3.3 A better neo-Davidsonian account

I believe that a more detailed discussion of the coordination problem reveals what might already be apparent: the primary problem in Krifka's account lies with how he associates thematic roles with verbal argument positions. In particular, the strict correspondence between thematic roles and syntactic thematic role features seems to be causing problems. First, we saw that if we were forced to resort to individual thematic roles, we would have problems finitely stating the syntactic feature set; second, we saw that in VP coordination, thematic role features unduly complicate the process of category matching without being able to preserve the correspondence between verbs and their appropriate thematic roles.

If we intend to be able to compare the Davidsonian account with the compositional neo-Davidsonian one, we must improve on Krifka's account before we proceed. In this section, I will provide an alternative which is somewhat more detailed than Krifka's account and responds to the main criticisms I have leveled against it. Instead of relying on syntactic features to guide the selection of thematic roles, I will complicate the semantic dimension of categories, annotating that dimension with an explicit sequence of thematic roles. Correspondingly, I adopt a different version of Function Application which accommodates this change.[11] In this account, the semantic dimension of categories can be either a model-theoretic object in the familiar sense, or a pair consisting of a model-theoretic object and a sequence of thematic roles. I will use individual thematic roles, simply because I believe they are more easily justified. I'm going to look ahead a bit and construct the thematic roles in such a way that they permit semantic argument lifting, in order to provide a version of Argument Raising for these special complex predicates. For no particular reason, I'll call the operation which "digests" my thematic roles Γ. The semantics of Γ corresponds to the recipe in (6.18) above:

(6.33) $\Gamma = \lambda\theta\lambda x\lambda P\lambda e[P(e) \wedge \theta(x)(e)]$

(6.34) $\langle$"write", $(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP}$, $\langle write', [\Gamma(writee'), \Gamma(writer')]\rangle\rangle$

I need to modify argument-taking in two ways. First, I need to specify its behavior when these new complex objects are functors. Second, I need to account for the behavior covered by Argument Raising for these special cases. Finally, I ought to make it clear that the original definitions of Function Application and Argument Raising still apply in the simple case.

For Function Application, the most oblique thematic role is combined with the argument and verbal predicate via the Γ operator to yield a new verbal predicate, while the remaining thematic indices are carried along. In the special case where there is only one thematic role, the pair structure is eliminated. I'm going to focus on the semantic dimension of Function Application; the syntactic and string dimensions are manipulated just as before:

(6.35) $\mathrm{FA}(\langle P, [\Gamma(\theta_i)|\Gamma(\vec{\theta})]\rangle, x) = \langle \Gamma(\theta_i)(x)(P), \Gamma(\vec{\theta})\rangle$

(6.36) $\mathrm{FA}(\langle P, [\Gamma(\theta_i)]\rangle, x) = \Gamma(\theta)(x)(P)]$

I now turn to Argument Raising. Since the verbal predicate itself has no argument position, we must lift the modified thematic role. Since the denotation of the grammatical argument and the verbal predicate are both arguments of this modified role, it has the right properties to be raised. I now define Argument Raising for the two cases corresponding to Function Application above. I present the whole rule, given its greater complexity:[12]

(6.37) For every meaning m of type c and every category A of type a and C of type c, $\mathrm{AR}(\langle\sigma, \mathrm{B}/_{\mathrm{R}}\mathrm{A}, \langle m, [\Gamma(\theta_i)|\Gamma(\vec{\theta})]\rangle\rangle, \mathrm{C}) =$
$\langle\sigma, \mathrm{B}/_{\mathrm{R}}(\mathrm{C}/_{\mathrm{R}}(\mathrm{C}/_{\mathrm{L}}\mathrm{A})),$
$\langle m, [\lambda x_{\langle\langle a,c\rangle,c\rangle}\lambda y_c[x(\lambda z_a[\Gamma(\theta_i)(z)(y)])]|\Gamma(\vec{\theta})]\rangle\rangle$

This definition is fairly complicated, so I will exemplify it rather than attempt to describe it. The case we're concerned with is the one where A is NP (and a is e), B is $\mathrm{V}/_{\mathrm{L}}\mathrm{NP}$, and C is V (so c is $\langle\epsilon, t\rangle$). Then categories C/(C/A) correspond to the type of Davidsonian generalized quantifiers, and the Argument Raised version of *write* is as follows:

(6.38) AR($\langle$"write",
$(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP}$, $\langle write', [\Gamma(writee'), \Gamma(writer')]\rangle\rangle) =$

⟨"write", (V/$_L$NP)/$_R$(V/$_R$(V/$_R$NP)),
$\langle write', [\lambda\mathcal{D}\lambda P[\mathcal{D}(\lambda x[\Gamma(writee')(x)(P)])], \Gamma(writer')]\rangle\rangle$

In order to make my proposal concrete, I present the derivation of *LaToya writes a song*:

(6.39)

LaToya	writes	a song
NP, l	(V/$_L$NP)/$_R$NP, $\langle write', [\Gamma(writee'), \Gamma(writer')]\rangle$	V/$_R$(V/$_L$NP) $a'(song')$
	(6.37): (V/$_L$NP)/$_R$(V/$_R$(V/$_L$NP)), $\langle write', [\lambda\mathcal{D}\lambda P[\mathcal{D}(\lambda x[\Gamma(writee')(x)(P)])], \Gamma(writer')]\rangle$	
	(6.35): V/$_L$NP, $\langle a'(song')(\lambda x[\Gamma(writee')(x)(write')]), [\Gamma(writer')]\rangle$	
(6.36): V, $\Gamma(writer')(l)(a'(song')(\lambda x[\Gamma(writee')(x)(write')]))$		

The final meaning of this derivation reduces as follows:

(6.40) $\Gamma(writer')(l)(a'(song')(\lambda x[\Gamma(writee')(x)(write')])) =$
$\lambda\theta\lambda x\lambda P\lambda e[P(e) \wedge \theta(x)(e)]$
$(writer')(l)(a'(song')(\lambda x[\Gamma(writee')(x)(write')])) =$
$\lambda e[a'(song')(\lambda x[\Gamma(writee')(x)(write')])(e) \wedge writer'(l)(e)] =$
$\lambda e[\lambda P\lambda E\lambda e[\exists y(P(y) \wedge E(y)(e))]$
$(song')(\lambda x[\Gamma(writee')(x)(write')])(e) \wedge writer'(l)(e)] =$
$\lambda e[\exists y(song'(y) \wedge \Gamma(writee')(y)(write')(e)) \wedge writer'(l)(e)] =$
$\lambda e[\exists y(song'(y) \wedge \lambda\theta\lambda x\lambda P\lambda e[P(e) \wedge$
$\theta(x)(e)](writee')(y)(write')(e)) \wedge writer'(l)(e)] =$
$\lambda e[\exists y(song'(y) \wedge write'(e) \wedge writee'(y)(e)) \wedge writer'(l)(e)]$

That is, the denotation of *LaToya writes a song* is that set of events in the denotation of *write* such that LaToya is the writer in the event and there is some song which is the writee in that event.

There are other tools besides Function Application and Argument Raising which must be reworked. For instance, in any neo-Davidsonian account (not just a compositional one), the effects of summativity must be reconstructed, if one adopts such an account for the semantics of neutral readings and the properties of *together* (cf. Chapter 3). We saw there that we could distinguish between distributive and collective participation by closing Davidsonian verbal denotations under the pairwise join operation and distinguishing between those tuples which correspond to atomic events and those which correspond to nonatomic events. However, we must do things a little differently in the neo-Davidsonian account, because participants are associated with events in a different way. The observation that the neutral readings of examples like (3.55a) from Chapter 3 can be captured in a thematic role account was made by Krifka (1989):

(3.55a) Michael and LaToya/two people washed ten cars.

As in Chapter 3, the reading of (3.55a) I intend here is one in which two people washed cars, and ten cars were washed, but no commitments are made about which people (or how many) washed which (or how many) cars. Krifka would analyze (3.55a) approximately as follows:

(6.41) $[\![\text{two people wash ten cars}]\!] =$
$$\lambda e[\exists x \exists y(wash'(e) \wedge cars'(y) \wedge |y| = 10 \wedge washee'(y)(e) \wedge people'(x) \wedge |x| = 2 \wedge washer'(x)(e))]$$

Following Krifka (1992), I will assume that thematic roles and event predicates are subject to summativity just as lexical order-based predicates are. So if e_1 is a $wash'$ and e_2 is a $wash'$, then so is $e_1 + e_2$; and if x is the $washer'$ of e_1, and y is the $washer'$ of e_2, then $x + y$ is the $washer'$ of $e_1 + e_2$. In this way, the neo-Davidsonian denotation of (3.55a) given here is true of those complex washing events whose atomic events have two $washer'$ people among them and ten $washee'$ cars among them. So the summativity-based account of neutral readings extends straightforwardly to the neo-Davidsonian case.

This account, as it stands, is incomplete. I have exemplified Function Application, quantification and Argument Raising; however, I have yet to demonstrate that this account (or any compositional neo-Davidsonian account, for that matter), is compatible with the complex operations which generate cases of nonconstituent coordination. For that matter, I have yet to show that the account I've presented solves the problem which Krifka's account exhibits in VP coordination.[13] But even if these questions can be addressed, they are premature in the context of the investigation to follow. In order for such demonstrations to be interesting, we must have some compelling need to pursue the compositional neo-Davidsonian option; that is, investigating these further issues of descriptive power in a compositional neo-Davidsonian account is nothing more than an intellectual exercise unless the account itself has some *raison d'être*.

So I can (finally) now turn to the question which prompted this study in the first place: should we adopt a compositional neo-Davidsonian strategy for semantics? I will assume that the compositional neo-Davidsonian account comes with a built-in penalty: among other things, we've seen that it compromises our concept of a tight type correspondence between syntactic and semantic categories. I will thus impose the burden of proof on the compositional neo-Davidsonian strategy, rather than the Davidsonian strategy; the latter is more conservative and more consonant with traditional concepts of the syntax/semantics map. So the question I turn to now is: can we justify a compositional neo-Davidsonian semantics?

Notes

[1]The roots of the idea go back to Pāṇini, actually.

[2]We will return to this topic in detail in Chapter 7.

[3]Some have claimed that this assumption cannot be made, but it is defended by both Landman (1993) and Parsons (1990). I will return to this issue in Chapter 8.

[4]Note that the elements of $\Theta_{write'}$ must be mutually disjoint.

[5]Techniques such as the one outlined here reinforce Dowty's implied position that the language acquisition problem does not argue for thematic roles, even if it argues for a crosslinguistically robust theory of argument selection which is tractable enough to explain child language learning. Dowty (1991) points out that argument selection principles stated directly in terms of basic properties like volition, etc., are probably more useful in this regard.

[6]I intend to remain agnostic on the issue of whether any category besides V ought to be given a neo-Davidsonian analysis.

[7]In the absence of a syntax/semantics map, thematic role accounts take many other forms (cf., for instance, Schein (1994) for a considerably different account), but I believe that (6.18) will serve as an appropriate characterization of the range of accounts I will consider.

[8]There are two details of Krifka's (1992) syntactic account which I have modified here for clarity. First, verbs in Krifka's account seem to take sets of arguments, rather than sequences of arguments; second, the example Krifka provides illustrates syntactic case features which I'm choosing to ignore.

In general, taking Krifka's account as a full-fledged neo-Davidsonian proposal might be somewhat overoptimistic, since Krifka (p.c.) emphasizes that his sole motivation for proposing a neo-Davidsonian account was to present a uniform definition of *cumulativity* and *quantization* across objects and events, and the complexities of order-based argument structure were something of a nuisance. I will demonstrate in Chapter 7 that while somewhat less convenient, such a uniform definition is indeed possible in Davidsonian terms.

[9]Krifka (1992) does not explicitly illustrate proper nouns, but Krifka (1989) shows that proper nouns and common nouns must be handled differently, and it seems clear to me that the same is required of his later account.

[10]In the discussion immediately below, I will ignore both strings and slash direction, for clarity.

[11] This change actually complicates Function Application considerably, a result which one might seize upon as evidence that such an account is misguided. Much to the contrary, I believe that the complexity of Function Application can be isolated, by defining more complex operations like Function Composition and generalized conjunction in terms of the operation of Function Application in the abstract, rather than in terms of any particular instantiation of it. However, this research is rather preliminary, and the results are too uncertain at this writing to present them in support of the neo-Davidsonian alternative.

[12]I present only the rightward-looking version here; the leftward-looking version is identical in all relevant respects.

[13]As I suggested in Footnote 11 above, I believe that more complex operations like generalized conjunction ought to be defined in terms of an abstract notion of Function Application. In such a framework, I think my neo-Davidsonian alternative in fact does address the issue of VP coordination. However, as I also suggested in footnote 11, this research is too preliminary to present in support of this conviction.

Chapter 7

Attempting to Justify Neo-Davidsonian Composition

In the last several chapters, we saw two compositional alternatives for formulating an event semantics: a Davidsonian strategy, presented in Section 4.3, and a neo-Davidsonian strategy, presented in Section 6.3.3. In this chapter, I will attempt to choose between these two strategies. I will examine the differences between the strategies and discuss what the parameters of choice may be. I will examine two major differences. First, these accounts can differ on the *obligatoriness* of semantic arguments; second, these accounts can differ on the *independence* of semantic arguments. I will describe each of these aspects in some detail. Then I will turn to the particular arguments, and argue that none of the purported advantages of the neo-Davidsonian alternative are consistent with the data. I will conclude that the neo-Davidsonian composition strategy cannot be supported.

7.1 Cumulativity and telicity

In the previous chapter, I discussed the compositional neo-Davidsonian account of Krifka (1992), which is one of the most explicit examples of this strategy. Krifka is motivated in large part by the related aspectual properties of nominal and verbal constituents. Accordingly, I will begin my discussion by reviewing Krifka's motivations, and arguing that Krifka's proposals are compatible with a Davidsonian account as well.

Krifka is primarily concerned with parallels between cumulative reference in nouns and telicity in verbs, as discussed by Bach (1986):

(7.1a) John drank wine for/*in an hour.
(7.1b) John drank a glass of wine in/*for an hour.

Krifka identifies the bare NP *wine* as *cumulative* (that is, it is closed under lattice-theoretic join) and *a glass of wine* as *quantized* (that is, no two elements stand in the part-of relation to each other):

(7.2a) $\forall P(CUM(P) \leftrightarrow \forall x \forall y((P(x) \wedge P(y)) \rightarrow P(x+y)))$
(7.2b) $\forall P(QUA(P) \leftrightarrow \forall x \forall y((P(x) \wedge P(y)) \rightarrow \neg x < y))$

Krifka's account is typologically unusual in that it analyzes NPs as sets of individuals, instead of either individuals or generalized quantifiers, but this is a simplifying assumption which does not bear on the issue at hand. What Bach observes is that with certain verbs, cumulativity of objects yields atelicity of the resulting event, while quantization of objects yields telicity of the resulting event, as we saw in (7.1) above. Krifka takes this observation to its next logical step; if we assume that events participate in lattice structures as objects do, then we can identify atelicity with cumulativity for events, and telicity with quantization for events, and show that these properties correspond to the traditional test for telicity, namely whether event predicts have a set terminal point or not.[1]

Krifka's central contribution, and the contribution which will concern us here, is that we can derive the telicity/atelicity of verb phrases given the cumulativity/quantization of the incorporated object, along with related properties of the argument position the object occupies. He adopts a neo-Davidsonian account to make this demonstration, because in such an account, verbal projections always correspond to sets of events, to which the definitions in (7.2) can be directly applied, without the additional overhead of ordered arguments. The proofs we will consider exploit the following potential properties of the thematic roles which relate objects and events:

(7.3a) Summativity:
$$\forall R(SUM(R) \leftrightarrow \forall e \forall e' \forall x \forall x'((R(e,x) \wedge R(e',x')) \rightarrow R(e+e',x+x')))$$
(7.3b) Uniqueness of objects:
$$\forall R(UNI{-}O(R) \leftrightarrow \forall e \forall x \forall x'((R(e,x) \wedge R(e,x')) \rightarrow x = x'))$$
(7.3c) Mapping to objects:
$$\forall R(MAP{-}O(R) \leftrightarrow \forall e \forall e' \forall x((R(e,x) \wedge e' \leq e) \rightarrow \exists x'(x' \leq x \wedge R(e',x'))))$$

(7.3d) Iterativity:

$$\forall e \forall x \forall R(ITER(e, x, R) \leftrightarrow R(e, x) \wedge \exists e' \exists e'' \exists x'(e' \leq e \wedge e'' \leq e \wedge e' \neq e'' \wedge x' \leq x \wedge R(e', x') \wedge R(e'', x')))$$

Summativity is our familiar definition of summativity for predicates, specialized to valence 2. Uniqueness of objects requires any event to be related to exactly one individual; this property corresponds to the principle of thematic uniqueness discussed in Section 7.2.3.3 below.[2] Mapping to objects requires any object related to any event to have every subpart related to some subpart of that event; in a reading event, for instance, every portion of the thing read is related to some subpart of the reading event itself, although there is no sense in which the subparts of the reader have the same property. Finally, iterativity requires any object related to an event to have a subpart which is related to two distinct subparts of that event; if the same part of a book is read twice in the same reading event, then the overall reading event is iterative with respect to that book and the relation of being read. These definitions do not exhaust the list of properties Krifka considers, but they are the ones we will consider.

So consider how one might prove that the VP *read letters* is atelic (cumulative). Consider the general case of a VP ϕ constructed from a lexical verbal predicate α, a nominal predicate δ corresponding to the direct object, and a thematic role θ:

(7.4) $\phi = \lambda e[\exists x(\alpha(e) \wedge \delta(x) \wedge \theta(e, x))]$

Krifka shows that ϕ is cumulative if α is cumulative, δ is cumulative and θ is summative. Assume two not necessarily distinct events $e_1, e_2 \in \phi$. Accordingly, $e_1, e_2 \in \alpha$ and there must be some $x_1, x_2 \in \delta$ such that $\theta(e_1, x_1), \theta(e_2, x_2)$. Because α and δ are cumulative, $\alpha(e_1 + e_2)$ and $\delta(x_1 + x_2)$. Because θ is summative, $\theta(e_1 + e_2, x_1 + x_2)$. It follows immediately that $e_1 + e_2 \in \phi$; in other words, ϕ is cumulative:

(7.5) $\forall \alpha \forall \delta \forall \theta((CUM(\alpha) \wedge CUM(\delta) \wedge SUM(\theta)) \rightarrow CUM(\lambda e[\exists x(\alpha(e) \wedge \delta(x) \wedge \theta(e, x))]))$

So take α to be $[\![\text{read}]\!]$, which we assume is cumulative, and assume that all thematic roles are summative. Now take δ to be $[\![\text{letters}]\!]$, which is cumulative; that is, for any two individuals which count as letters, their sum counts as letters as well. By the proof just outlined, the VP *read letters* is cumulative as well.

On the other hand, how might we prove that ϕ is quantized? Note that a nominal predicate like *a letter* induces telic/quantized VPs, and such a nominal predicate is not cumulative according to the definition above; the sum of two individuals each of which qualify as a letter is not itself a letter. Krifka shows that if θ obeys uniqueness of objects and mapping to objects, iterative interpretations are excluded, and δ is quantized, we can show that ϕ must be quantized as well. Assume to the contrary that $e_1, e_2 \in \phi$ and $e_2 < e_1$. By the definition of ϕ, there are $x_1, x_2 \in \delta$ such that $\theta(e_1, x_1), \theta(e_2, x_2)$. Since θ obeys mapping to objects, there is some $x_3 \leq x_1$ such that $\theta(e_2, x_3)$, and since θ obeys uniqueness of objects, $x_3 = x_2$ and therefore $x_2 \leq x_1$. Since $\theta(e_2, x_2), e_2 < e_1$ and iterative interpretations are excluded, we can infer that $x_1 \neq x_2$, and thus $x_2 < x_1$. But this is impossible if δ is quantized. Therefore our initial assumption must be wrong, and there are no events $e_2 < e_1$ such that $e_1, e_2 \in \phi$; that is, ϕ is quantized:

(7.6) $$\forall\delta\forall\alpha\forall\theta\forall e\forall x((QUA(\delta) \wedge UNI\!-\!O(\theta) \wedge MAP\!-\!O(\theta) \wedge \neg ITER(e, x, \theta)) \rightarrow QUA(\lambda e[\exists x(\alpha(e) \wedge \delta(x) \wedge \theta(e, x))]))$$

So VPs like *read two letters* and *read a letter* are quantized, because *a letter* and *two letters* are quantized, and the relation of being read obeys uniqueness of objects and mapping to objects.

While Krifka's observations are best couched in neo-Davidsonian terms, it is by no means necessary that they be; in fact, they may be representable in Davidsonian terms as well.[3] As an illustration, I will reconstruct the two proofs I have just presented.

For instance, how might we go about proving that a Davidsonian VP *read letters* is cumulative? In order to explore this question, we must discuss some background. First, recall that we assume that all Davidsonian lexical verbal predicates are summative; note further that cumulativity as defined above is simply summativity for valence 1. Krifka's definitions of cumulativity and summativity thus reduce to the proposed generalization of summativity for all lexical verbal predicates. Second, it would be more consonant with the Davidsonian approach outlined so far to define cumulativity for NPs in terms of generalized quantifiers, rather than assuming that NPs like *a letter* denote sets of individuals. Recall that we adopt Partee's type-shifter A to construct generalized quantifiers out of "bare" CN denotations; here we adapt it for Davidsonian purposes:

(7.7) $$A' = \lambda P\lambda E\lambda e[\exists x(P(x) \wedge E(x)(e))]$$

We will further assume that this interpretation is also the interpretation of the indefinite determiner *a(n)*. If we retain our modifier analysis of cardinal numbers, then we can conclude that the NPs *a letter*, *letters* and *two letters* are all examples of CNs shifted into the type of generalized quantifiers using the interpretation A'. It is this subset of generalized quantifiers that I will consider.

Now assume that $letter'$ is a set of atoms, and that $letters'$ is the closure of that set of atoms under join, as discussed in Chapter 3 above. Then the CN *letters* is cumulative, since its denotation is $letters'$, but the CN *two letters* is not, because the sum of two distinct individuals of size 2 is not of size 2. Similarly, we can show that *letter* is also not cumulative, because it is restricted to atoms and the sum of two atoms is not an atom.

At this point, we are ready to examine initially the properties of the Davidsonian equivalent of ϕ:

(7.8) $\phi' = \lambda x \lambda e[\exists y(\delta(y) \wedge R(y)(x)(e))]$

The denotation ϕ' is the result of applying the shifter A' to the CN denotation δ, argument-raising the Davidsonian lexical verbal predicate R, and reducing:

(7.9) $\lambda\mathcal{D}\lambda x[\mathcal{D}(\lambda y\lambda e[R(y)(x)(e)])](A'(\delta)) =$
$\lambda\mathcal{D}\lambda x[\mathcal{D}(\lambda y\lambda e[R(y)(x)(e)])](\lambda P\lambda E\lambda e[\exists z(P(z) \wedge$
$E(z)(e))](\delta)) =$
$\lambda\mathcal{D}\lambda x[\mathcal{D}(\lambda y\lambda e[R(y)(x)(e)])](\lambda E\lambda e[\exists z(\delta(z) \wedge E(z)(e))]) =$
$\lambda x[\lambda E\lambda e[\exists z(\delta(z) \wedge E(z)(e))](\lambda y\lambda e[R(y)(x)(e)])] =$
$\lambda x\lambda e[\exists z(\delta(z) \wedge \lambda y\lambda e[R(y)(x)(e)](z)(e))] =$
$\lambda x\lambda e[\exists z(\delta(z) \wedge R(z)(x)(e))]$

According to our assumptions, because R is a Davidsonian lexical verbal predicate, it is summative. Assume that δ is cumulative, such as the CN *letters*. We can prove that under these circumstances that ϕ' is summative, like R. Assume two tuples $\langle e_1, x_1, y_1\rangle, \langle e_2, x_2, y_2\rangle \in R$. By summativity, we know $\langle e_1 + e_2, x_1 + x_2, y_1 + y_2\rangle \in R$ as well. Assume further that $y_1, y_2 \in \delta$. Therefore, we know that $\langle e_1, x_1\rangle, \langle e_2, x_2\rangle \in \phi'$, since there is some individual z which is a δ such that the relevant tuples are in R. Since δ is cumulative, then $y_1 + y_2 \in \delta$ as well, and thus we also know that $\langle e_1 + e_2, x_1 + x_2\rangle \in \phi'$, because there is a δ (namely, $y_1 + y_2$) such that the relevant tuple is present in R. But this means that ϕ' is summative, and we've duplicated Krifka's first proof.

In order to prove quantized reference for Davidsonian VPs, I must do a little more work. First, we need to say what it means for a set of tuples to exhibit quantized reference:

(7.10) $\forall R^n(QUA(R^n) \leftrightarrow$
$$\forall x_1, \ldots, x_n \forall y_1, \ldots, y_n$$
$$((R^n(x_1, \ldots, x_n) \wedge R_n(y_1, \ldots, y_n)) \rightarrow$$
$$\neg(x_1 < y_1 \wedge \ldots \wedge x_n < y_n)))$$

In other words, a relation R is quantized if no tuple in R is a pairwise proper part of another tuple in R. Next, we need to isolate the relation between an event and a particular argument position in order to describe the properties of uniqueness of objects, mapping to objects, and iterativity. The easiest way to do this is to define "thematic roles" θ_i in terms of R^n:

(7.11) For any Davidsonian relation R^n and any argument position i, where $n - 1 \geq i \geq 1$,
$$\theta_{i,n} = \lambda y \lambda e[\exists x_1, \ldots, x_{i-1}, x_{i+1}, \ldots, x_{n-1}$$
$$(R^n(e, x_1, \ldots, x_{i-1}, y, x_{i+1}, \ldots, x_{n-1}))]$$

That is, we existentially quantify over all argument positions besides the ones we're interested in. Since we're primarily concerned here with the object position of transitive Davidsonian verbal predicates, I present the instantiation of this definition for argument position 2 of relations of valence 3:

(7.12) $\theta_{2,3} = \lambda y \lambda e[\exists x(R(e, x, y))]$

We are now in a position to demonstrate that ϕ' in (7.8) above is quantized just in case δ is quantized, $\theta_{2,3}$ satisfies mapping to objects and uniqueness of objects, and iterative readings with respect to $\theta_{2,3}$ are excluded. We begin by assuming that δ is quantized and that ϕ' is not quantized; that is, we assume $\langle e_1, x_1 \rangle, \langle e_2, x_2 \rangle \in \phi'$ and $e_2 < e_1, x_2 < x_1$. By ϕ', there must be $y_1, y_2 \in \delta$ such that $\langle e_1, x_1, y_1 \rangle, \langle e_2, x_2, y_2 \rangle \in R$. Because $e_2 < e_1$ and $\theta_{2,3}$ satisfies mapping to objects, there must be some $y_3 \leq y_1$ such that $\exists x(R(e_2, x, y_3))$. Since $\theta_{2,3}$ satisfies uniqueness of objects, $y_3 = y_2$ and thus $y_2 \leq y_1$. Because iterative readings are excluded with respect to $\theta_{2,3}$, we can infer that $y_1 \neq y_2$, and therefore $y_2 < y_1$. But this contradicts the assumption that δ is quantized, since $y_1, y_2 \in \delta$ and $y_2 < y_1$. Therefore, our initial assumptions are inconsistent, and ϕ' must be quantized.

This discussion by no means exhausts Krifka's discussion of the properties of reference transfer in event semantics. However, it illustrates at least that it is possible, although perhaps awkward, to prove the same results in a Davidsonian framework as Krifka proves in a neo-Davidsonian framework. With this prologue, I turn to the purported distinctions between the two composition strategies.

7.2 Obligatoriness and the argument/adjunct distinction

7.2.1 *Background*

Consider once again the Davidsonian denotation of a verb like *touch*:

(7.13) $[\![\text{touch}]\!] = \lambda y \lambda x \lambda e[touch'(y)(x)(e)]$

Aside from the final Davidsonian element argument, this predicate has two semantic arguments, each of which must be filled. If we wish to use this predicate to express the interpretation of *LaToya is touched*, we must provide a logical subject. The simplest method is to fill the argument position with a variable bound by an existential quantifier:

(7.14) $[\![\text{LaToya is touched}]\!] = \lambda e[\exists x(touch'(l)(x)(e))]$

This operation of existential closure ought to look familiar, since it bears a strong resemblance to the existential closure over events featured in Davidsonian and neo-Davidsonian semantics. The application of existential closure here differs in that the filler of the semantic argument position in question here typically corresponds to a surface syntactic constituent, but its semantic motivation is the same: if we wish to derive a semantic constituent of type t in an order-based account, we must guarantee that every semantic argument position is filled.

Contrast this account with the compositional neo-Davidsonian account:

(7.15) $[\![\text{touch}]\!] = \lambda e[touch'(e)]$

We saw in Chapter 6 that any compositional neo-Davidsonian account must be able to supply a thematic role corresponding to each syntactic argument position. However, a single lexical neo-Davidsonian predicate such as in (7.15) might correspond to multiple subcategorization frames, which might pair the predicate with different arrays of thematic roles. Since under the compositional neo-Davidsonian account, the lexical predicate has no valence of its own beyond the Davidsonian element argument, there are no semantic arguments which require saturation, and an Agentless Passive is free to differ from the active in the number of thematic roles it references:

(7.16a) $[\![\text{Michael touches LaToya}]\!] =$
$$\lambda e[touch'(e) \wedge toucher'(m)(e) \wedge touchee'(l)(e)]$$
(7.16b) $[\![\text{LaToya is touched}]\!] =$
$$\lambda e[touch'(e) \wedge touchee'(l)(e)]$$

So the compositional neo-Davidsonian account, then, differs from the Davidsonian in the obligatoriness of semantic arguments. This contrast has implications for the relationship between arguments and adjuncts as well, as we will see. All of the arguments in favor of a neo-Davidsonian account put forward by Parsons (1990) are of this type, as is the primary argument of Carlson (1984). The argument for neo-Davidsonian composition inside NP put forward by Dowty (1989) also falls into this category, I believe. I think all of these arguments can be replied to convincingly, and that none of them comprise a forceful (or even plausible) motivation for neo-Davidsonian composition.

7.2.2 *Parsons and Carlson*

The arguments I will consider in this section are taken from Parsons and Carlson, as well as data due to Mittwoch. They claim that:

- there is no reason to assume that the distinction between Davidsonian and neo-Davidsonian argument indexing corresponds precisely to the contrast between arguments and adjuncts (Parsons (1990), p. 94);

- detransitivization operations in Davidsonian accounts require existential quantification over argument positions which sometimes makes the wrong predictions (Carlson (1984), pp. 263-5; Mittwoch (1982)); and

- unreal contexts like dreams support readings similar to the Carlson cases which suggest that while the presence of certain participants is necessary in the real world, it ought not be a property of semantic representations (Parsons (1990), pp. 97-9)

I will address each of these points in turn.

7.2.2.1 Arguments, adjuncts and indexing

Parsons' first point isn't an argument in favor of neo-Davidsonian semantics so much as a claim about the underlying assumptions that can be made in the context of the debate. In some sense, the contrast between Davidsonian and neo-Davidsonian representations is entirely a debate about which dependents of the verb are indexed by order, and which by explicit relation. On many of these dependents, the two accounts agree: assuming a distinct Davidsonian element, temporal, locative, directional, comitative and instrumental complements are typically associated with events by explicit relations, such as the meanings of prepositions:

(7.17) Davidsonian:
$[\![\text{LaToya arrived at noon}]\!] =$
$\lambda e[arrive'(l)(e) \wedge at'(e)(noon')]$

(7.18) neo-Davidsonian:
$[\![\text{LaToya arrived at noon}]\!] =$
$\lambda e[arrive'(e) \wedge \theta_{SU,arrive'}(l)(e) \wedge at'(e)(noon')]$

Parsons points out that a common assumption is made in the Davidsonian school that syntactic arguments are indexed by order and adjuncts are indexed by explicit relations, and says that there is no reason to expect this parallel. Rather, the question that should be asked is: which arguments ought to be indexed by order and which by role?

The problem with Parsons' attempt to reframe the issue is that his revised question has no ontologically justifiable answer. There are two ways of looking at Parsons' question, and under both interpretations it turns out that role-based and order-based argument indexing in semantic composition are by and large ontologically interchangeable. Assume first that Parsons intends his question to be about the process of associating participants with events in semantic composition. We can show that order-based indexing can correspond to thematic roles, and role-based indexing can correspond to order. The demonstration that order-based indexing can correspond to thematic roles is simple. As illustrated previously in (6.3), the lexical neo-Davidsonian strategy incorporates semantic arguments via order, but relates them to events via thematic roles:

(6.3) Lexical neo-Davidsonian:
$[\![\text{run}]\!] = \lambda x \lambda e[run'(e) \wedge \theta_{SU,run'}(x)(e)]$
$[\![[_V \text{ John run}]]\!] = \lambda e[run'(e) \wedge \theta_{SU,run'}(j)(e)]$
$[\![\text{John runs}]\!] = \exists e(run'(e) \wedge \theta_{SU,run'}(j)(e))$

The demonstration that role-based indexing can correspond to order is a little more complicated. Recall the compositional neo-Davidsonian strategy from Chapter 6:

(6.4) Compositional neo-Davidsonian:
$[\![\text{run}]\!] = \lambda e[run'(e)]$
$[\![[_V \text{ John run}]]\!] = \lambda e[run'(e) \wedge \theta_{SU,run'}(j)(e)]$
$[\![\text{John runs}]\!] = \exists e(run'(e) \wedge \theta_{SU,run'}(j)(e))$

Such a strategy leaves open the issue of what sort of elements the Davidsonian elements are, and what the interpretation of the thematic roles is. Consider, then, the possibility that run' in (6.4) means exactly the same thing as the classical Davidsonian run' does; namely, it denotes a set of tuples each of which contains a distinguished event individual. This proposal is an instance of Davidsonian elements as complex objects, in this case tuples. Thematic roles are now relations between participants and Davidsonian elements – that is, tuples – and what they do is associate participants with positions in the tuple. We implement this with the position accessors $\pi_2, \ldots, \pi_n$, where π_1 is always associated with the Davidsonian event argument:

(7.19a) $run' = \{\langle e_1, j\rangle, \langle e_2, m\rangle, \ldots\}$
(7.19b) $\pi_1(\langle e_1, j\rangle) = e_1$
(7.19c) $\pi_2(\langle e_1, j\rangle) = j$
(7.19d) $\theta_{SU} = \pi_2$
...

So while the composition strategy associates arguments with Davidsonian elements by explicit relations, the underlying model-theoretic structure is based on order. I do not intend to defend this particular strategy (which strikes me as a little perverse, frankly); I simply wish to demonstrate that the choice of composition strategy is to a great degree independent of what primitives are found in the supporting model.

The second way of interpreting Parsons' question is that it is about the *result* of semantic composition. It is much clearer here that Parsons' question has no ontological force. For instance, the interpretation of any constituent of category V in either the Davidsonian or neo-Davidsonian strategies outlined in the previous chapters is a set of events; the "internal structure" of these elements has been lost, so questions of indexing by role vs. indexing by order are irrelevant. If we permit ourselves to examine the internal structure of Davidsonian or neo-Davidsonian sentential interpretations – that is, if we understand such interpretations as logical forms or structured meanings – we are, surprisingly, not much better off. Consider, for instance, the Davidsonian account in (6.2), repeated here:

(6.2) Davidsonian:
$[\![\text{run}]\!] = \lambda x \lambda e[run'(x)(e)]$
$[\![[_{\text{V}} \text{ John run}]]\!] = \lambda e[run'(j)(e)]$
$[\![\text{John runs}]\!] = \exists e(run'(j)(e))$

Does the interpretation of the V constituent here as a logical form differ from that of (6.3) above? Surprisingly, no. In order to determine the ontological implications of the choice between the two interpretations, we have to know what all of the predicates in the logical forms mean, and it's entirely possible that the interpretation of run' is exactly equivalent to the neo-Davidsonian logical form in (6.3), as illustrated in the meaning postulate in (7.20):

(7.20) $\Box \forall x \forall e[run'_{Davidsonian}(x)(e) \leftrightarrow run'_{neoDavidsonian}(e) \wedge \theta_{SU,run'}(x)(e)]$

Alternatively, it's possible that the elements in the neo-Davidsonian logical form might be assigned interpretations which render them order-based, just as we saw in the tuple-based interpretation of the compositional neo-Davidsonian strategy above.

So under either possible interpretation of Parsons' question, the two potential answers to the question are ontologically interchangeable. So on what basis might we decide whether a given argument is to be indexed by order or by role? As far as I can tell, the only plausible criterion for choice which remains is the feasibility of the required composition strategy. That is, asking Parsons' question can only amount to attempting to choose between an order-based indexing strategy on the one hand (that is, a Davidsonian or lexical neo-Davidsonian strategy) and a role-based strategy on the other (that is, a compositional neo-Davidsonian strategy). But if what we're doing is choosing composition strategies, then the syntactic contrast between argument and adjunct immediately becomes relevant. In particular, *contra* Parsons, there's nothing at all surprising about a composition strategy which holds that all arguments are indexed by order and all adjuncts by role, because it is the properties of syntactic structure which drive the semantic interpretation. In other words, once we recognize that Parsons' question cannot be interpreted in ontological terms, we must conclude that his attempt to reframe the problem is misguided, because the compositional considerations which guide indexing decisions render the parallels Parsons observes utterly unsurprising.

7.2.2.2 Making intransitives

Our first true argument comes from Carlson (1984). Carlson points out that operations of Detransitivization and Passive typically require existential closure of missing arguments in order-based accounts:

(7.21) $[\![\text{Michael ate}]\!] = \lambda e[\exists x(eat'(x)(m)(e))]$

(7.22) $[\![\text{LaToya was criticized}]\!] = \lambda e[\exists x(criticize'(l)(x)(e))]$

These interpretations might be obtained through valence-reducing operations such as those proposed by Dowty (1982). I present my own versions here:

(7.23) Detransitivization:
$\langle \sigma, (\text{V}/_{\text{L}}\text{NP})/_{\text{R}}\text{NP}, R_{\langle e,\langle e,\langle \epsilon,t\rangle\rangle\rangle} \rangle \Rightarrow$
$\langle \sigma, \text{V}/_{\text{L}}\text{NP}, \lambda x \lambda e[\exists y(R(y)(x)(e))] \rangle$

(7.24) Passive:
$\langle \sigma, (\text{V}/_{\text{L}}\text{NP})/_{\text{R}}\text{NP}, R_{\langle e,\langle e,\langle \epsilon,t\rangle\rangle\rangle} \rangle \Rightarrow$
$\langle \sigma', \text{V}/_{\text{L}}\text{NP}, \lambda x \lambda e[\exists y(R(x)(y)(e))] \rangle$[4]

Carlson points out that not all passives or intransitives corresponding to transitives act this way:

(7.25a) The dancer kicked LaToya.
(7.25b) The dancer kicked.

(7.25c) The dancer kicked something.

(7.26a) Michael was left alone.
(7.26b) Michael was left alone by everyone.
(7.26c) Michael was left alone by someone.

Carlson argues that if (7.25b) involves the application of the rule in (7.23), then it ought to entail (7.25c), but it doesn't, and that if (7.26a) involves the application of the rule in (7.24), then it ought to entail (7.26c), but it actually entails (7.26b) instead. Carlson argues that if we assume that existential closure over unspecified participants isn't a property of the sentential semantics, life becomes easier. Assume a compositional neo-Davidsonian account for a moment. Then in Carlson's world, the existential entailment embodied in (7.23), for instance, is manifested in lexical entailments like the following:

(7.27a) $\Box\forall e[eat'(e) \rightarrow \exists x(eatee'(x)(e))]$
(7.27b) $\Box\forall e[kick'(e) \rightarrow \exists x(kickee'(x)(e))]$

For Carlson, (7.27a) holds, but (7.27b) does not. This contrast cashes out in the obvious way. Let's adopt the following neo-Davidsonian version of the rule of Detransitivization, couched in the neo-Davidsonian framework of Chapter 6:

(7.28) Detransivization:
$\langle\sigma, (\mathrm{V/_LNP})\mathrm{/_RNP}, \langle P, [\Gamma(\theta_{DO,P}), \Gamma(\theta_{SU,P})]\rangle\rangle \Rightarrow$
$\langle\sigma, \mathrm{V/_LNP}, \langle P, [\Gamma(\theta_{SU,P})]\rangle\rangle$

The derivation of (7.21) proceeds as follows:

(7.29)
$$\cfrac{\cfrac{\text{Michael}}{\text{NP}, m} \qquad \cfrac{\cfrac{\text{ate}}{(\mathrm{V/_LNP})\mathrm{/_RNP}, \langle eat', [\Gamma(eatee'), \Gamma(eater')]\rangle}}{\textbf{(7.28)}\text{: } \mathrm{V/_LNP}, \langle eat', [\Gamma(eater')]\rangle}}{\textbf{(6.36)}\text{: V, } \Gamma(eater')(m)(eat')}$$

The final interpretation of this example reduces as follows:

(7.30) $\Gamma(eater')(m)(eat') =$
$\lambda\theta\lambda x\lambda P\lambda e[P(e) \wedge \theta(x)(e)](eater')(m)(eat') =$
$\lambda e[eat'(e) \wedge eater'(m)(e)]$

The *kick* example in (7.25b) is interpreted analogously. Notice that this interpretation makes no reference to the argument eliminated by Detransitivization. Since the meaning postulate in (7.27a) holds, the events described in (7.30) will necessarily involve something eaten; but since the meaning postulate in (7.27b) does not hold, any analogously described kicking events will not necessarily involve something kicked. Under an order-based account, a different rule of Detransitivization would be required, but nothing would seem to predict such a contrast; in Carlson's account, the contrast is purely a function of facts about the world, independent of syntax, as Carlson implies it ought to be.

The issue which lies behind Carlson's observation is the relationship between argument indexing and ontological requirements about participation. If we claim that *eat* has the Davidsonian denotation eat', where eat' is a three-place relation among two participants and an event, then in some sense we're claiming that every eating has an eater and a thing eaten, and furthermore that claim follows directly from our choice of order-based argument indexing. If we passivize or detransitivize *eat*, the resulting predicate has a smaller valence, but it's still defined in terms of eat', and existential closure embodies the requirement that the syntactically unrealized participant exist. Furthermore, the grammatical architectures we typically work with do not permit us to choose an order-based strategy for some verbs and a role-based strategy for others; by virtue of choosing an order-based strategy, we make the implicit claim that *every* verbal predicate imposes automatic requirements on how many participants its events requires.

On the other hand, if we claim that *eat* denotes a set of events and nothing more, then we make no claims at all about which participants are required. If every eating has an eater and a thing eaten, and this fact is relevant to compositional semantics, we must state this fact explicitly, as exemplified in the meaning postulate in (7.27a). That is, the role-based strategy is utterly silent about how many participants are required by events.

Carlson's argument is that if we must choose between the ontological implications of these two indexing strategies, we ought to choose the role-based strategy, since the exceptional nature of predicates like *kick* demonstrates that the ontological properties implied by the order-based account do not universally hold. It seems that he has uncovered an aspect of the contrast between order-based and role-based indexing which has makes genuine semantic predictions, and seems to favor the role-based account. This argument is exactly the sort of argument which meets the criteria for choice, since the contrast is a function of the interaction between semantic composition and surface valence.

But is the argument right? Dowty (1989; 1993) argues that it is not. He argues that the majority of verbs exhibit some sort of participant entailment as a result of Detransitivization:[5]

(7.31) Existential: LaToya ate (= LaToya ate something)

(7.32) Reflexive: Jermaine shaved (= Jermaine shaved himself)

(7.33) Anaphoric: (Janet entered, but) no one noticed (= no one noticed Janet enter)

Dowty argues that deriving these reflexive and anaphoric entailments would require a separate derivational rule, or explicit listing in the lexicon. To see why, consider how one might have to use Carlson's meaning postulate approach to handle the reflexive entailment of *shave*:

(7.34) $\Box\forall e[shave'(e) \rightarrow \lambda x[shavee'(x)(e)] = \lambda x[shaver'(x)(e)]]$

Of course, such a meaning postulate is blatantly wrong; it is not a property of shaving *per se* that shavers and shavees must be identical, but only a property of intransitive *shave*. That is, it turns out that the reflexive entailment in question is not a property of events, but of the subcategorization frame. So the apparent advantage of Carlson's approach vanishes when we need to state different entailments, rather than having no entailment at all.

Carlson's Passive argument based on (7.26a) falls apart in a similar way. Under Carlson's account, *leave alone* would have to entail that any event of leaving alone is one in which the one left alone is left alone by everyone; however, this entailment is false, as illustrated in (7.35), which is consistent with a world in which the only person who leaves Michael alone is LaToya:

(7.35) Michael was left alone by LaToya.

That is, the universal entailment exhibited in (7.26b) is not a property of leaving alone events, but rather a property of Agentless Passive *leave alone*.

If these sorts of entailments are properties not of events but of verbal subcategorization frames, then it seems that associating these sorts of entailments with subcategorization frames is the right thing to do, and this essentially the order-based account of Dowty (1982).[6] If there is a problem with Dowty's account, it is in the implication that the rules Dowty presents are universal; however, Dowty himself has pointed out that such rules are subject to exception, and do not exclude the possibility that lexical entries with unpredictable interpretations but similar output forms might exist. Thus, upon consideration of a wider range of data, Carlson's proposal solves little, and requires more machinery than the order-based account.

7.2.2.3 Intransitives and aspect

As observed by Mittwoch (1982), a range of aspectual contrasts separates transitives from their detransitivized counterparts, even when the object of the transitive is the NP *something*. The contrast between *for-* and *in-* adverbials will illustrate:

(7.36a) LaToya drank something in/*for five minutes.
(7.36b) LaToya drank for/*in five minutes.

If the denotation of *something* is an unrestricted existential generalized quantifier, and the rule of Detransitivization is the one presented in (7.23) above, then nothing accounts for the contrast in (7.36) in the Davidsonian account:

(7.37) $\langle$"eat", $(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP}$, $eat'\rangle \Rightarrow$ (via (7.23))
$\langle$"eat", $\mathrm{V}/_{\mathrm{L}}\mathrm{NP}$, $\lambda x \lambda e[\exists y(eat'(y)(x)(e))]\rangle$

(7.38a) $[\![\text{something}]\!] = \lambda E \lambda e[\exists x(E(x)(e))]$
(7.38b) $[\![\text{eat something}]\!] =$
$$\lambda \mathcal{D} \lambda x[\mathcal{D}(\lambda y \lambda e[eat'(y)(x)(e)])](\lambda E \lambda e[\exists z(E(z)(e))]) =$$
$$\lambda x[\lambda E \lambda e[\exists z(E(z)(e))](\lambda y \lambda e[eat'(y)(x)(e)])] =$$
$$\lambda x \lambda e[\exists z(\lambda y \lambda e[eat'(y)(x)(e)](z)(e))] =$$
$$\lambda x \lambda e[\exists z(eat'(z)(x)(e))]$$

On the other hand, as Carlson suggested above for other reasons, the contrast between the presence and absence of participants which arises in the neo-Davidsonian account of Detransitivization in (7.28) might hope to distinguish between the two cases in (7.36) in some as-yet-unspecified way.[7]

However, Mittwoch also provides the answer to this puzzle, although it's not exactly clear that she recognizes it. In an appendix, she argues that the evidence slightly favors the conclusion that *something* is a count rather than mass element. If this conclusion is correct, then *something* is a singular count element, which means that the restrictor of the existential quantifier is a quantized predicate of some sort. As Krifka's arguments in Section 7.1 above make clear, it is cumulative object nominal predicates which induce an atelic reading compatible with *for*-adverbials, and quantized object nominal predicates which induce a telic reading compatible with *in*-adverbials (assuming the object position supports mapping to objects and uniqueness of objects, which is true of *drink*). So if *something* corresponds to a quantized predicate, then it can only induce *in*-adverbials, while the unrestricted existential quantification induced by Detransitivization embraces the entire domain of individuals, which is closed under join, and therefore cumulative, and as a result can only induce *for*-adverbials.

This analysis of the aspectual properties of *something* is by no means complete. As Mittwoch notes, singular *something* can correspond to masses; so (7.39) can describe a situation in which Jermaine eats cake:

(7.39) Jermaine ate something.

However, since what Jermaine ate was a specified quantity of cake, the elements which *something* quantifies over might still be drawn from a quantized predicate.

More problematically, it's not clear *which* quantized predicate serves as the restrictor for *something*. It would be careless to propose that it be the union of all quantized predicates, since the resulting predicate is not quantized; the quantized predicate *one sandwich* contains all the atomic sandwiches in the world, while the quantized predicate *two sandwiches* contains all the sums of sandwiches of size two, and the union of those two predicates contains elements (namely, atomic sandwiches) which are subparts of other elements (namely, sums of atomic sandwiches), contradicting the definition of quantization in (7.2) above. Nevertheless, I think the cumulativity properties of *something* are the proper place to look to for an explanation of the aspectual contrast in (7.36), without needing to resort to a neo-Davidsonian explanation.

7.2.2.4 Parsons and the interpretation of dreams

The second argument in favor of thematic roles I'll consider comes from Parsons again. This argument is a variation of Carlson's, but deserves to be examined independently. Parsons argues that even if Carlson is wrong, and the existence of participants for events is by and large necessarily entailed, these entailments nevertheless ought not be immediate consequences of compositional semantics. He argues that in describing unreal situations, such as those found in dreams, assumptions which hold in the real world ought not to constrain semantic descriptions. For instance:

(7.40) In a dream, I was stabbed, but not by anybody.

Parsons intends this utterance as a description of an incoherent dream, one which in the real world is contradictory, one where the speaker, in the dream, experiences being stabbed, but not by anyone. Under a Davidsonian compositional strategy, the unspecified agent must be mentioned in the semantics in some way (such as by existential quantification), but that would make (7.40) explicitly contradictory. Parsons argues that the dream might be contradictory, but the speaker is accurately reporting his "observation", and ought not to be held to have uttered something contradictory. Under the neo-Davidsonian account, the argument is genuinely missing, and we can simply "suspend" the appropriate entailment in the dream world without perturbing sentential semantic composition.

Dowty (1993) replies that this sort of report seldom makes sense. He presents (7.41) as examples of utterances which make no sense even as reports of dreams:

(7.41a) I dreamed that I built, but I didn't build anything.
(7.41b) I dreamed that there was an event of giving, but in that event nobody gave anything to anybody.

I believe that this response can be expanded on significantly, and in fact it is alluded to by Parsons himself (p. 99, fn. 25). Consider (7.42):

(7.42) In a dream, someone kissed me, but no one touched me.

This example is a case of another sort of "compromise" struck in dream reports. It is a fact about kissing that it necessarily involves touching:

(7.43) $\Box[\forall x \forall y \forall e(kiss'(y)(x)(e) \rightarrow touch'(y)(x)(e))]$

However, in order to understand (7.42), this entailment must somehow be suspended. But if this entailment holds universally of the predicate $kiss'$, it can't be the predicate $kiss'$ which occurs in the interpretation of (7.42); it must be some other predicate, one which means something like "to experience all the sensations associated with kissing". That is, if the meaning postulate truly holds universally, then whatever the report in (7.42) means, it cannot be referring to kissing as we commonly understand it.

The same, of course, can be said for *stab* in (7.40). Once we establish that our descriptions of dreams force us to "improvise" in some way, Parsons' example simply reduces to another instance of the same process, and has nothing to do with the choice between Davidsonian and neo-Davidsonian composition strategies. In this light, Dowty's counterexamples in (7.41) are simply reflections of the fact that the improvisation process is restricted in some way. Thus, the third argument as well fails to justify neo-Davidsonian composition.

7.2.3 Dowty on nominal arguments

So far, we've seen no reason to adopt neo-Davidsonian semantic composition. The compositional semantics of verbs, so far, seems to be straightforwardly expressible in an order-based Davidsonian approach. But verbs aren't the only complement-taking linguistic elements. Do these conclusions extend, for instance, to the nominalizations of these verbs?

Dowty (1989) explores the possibility that they do not. His primary motivation is the implications made by the differing argument-taking properties of nouns and verbs. Verbs tend to exhibit a wide range of arbitrary subcategorization frames, and many of their arguments are obligatory. Nouns, on the other hand, seem to exhibit very little on a par with verbal subcategorization frames; for instance, all of the arguments of *gift* are optional:

(7.44a) the gift of a book from LaToya to Jermaine
(7.44b) the gift of a book to Jermaine
(7.44c) the gift from LaToya to Jermaine
(7.44d) the gift of a book from LaToya
(7.44e) the gift of a book

(7.44f) the gift from LaToya
(7.44g) the gift to Jermaine
(7.44h) the gift

In the spirit of a strict correspondence between syntax and semantics, Dowty speculates that this syntactic contrast between nouns and verbs might be mirrored in a contrast between nominal and verbal argument indexing. He proposes that verbs, which take arbitrary sets of obligatory arguments, embrace an order-based indexing strategy, while nouns, which take optional arguments, embrace a neo-Davidsonian indexing strategy in which no semantic arguments are obligatory.

Dowty admits that at best, this proposal is an oversimplification. However, he does present a number of arguments which purport to support it. I think that it is easy to demonstrate that none of these arguments stand up to scrutiny. In particular, we'll see that upon closer examination, a number of Dowty's observations turn out to endorse *parallels* between nouns and verbs rather than contrasts. To that extent, his discussion supports neither Davidsonian nor neo-Davidsonian composition, but rather a common solution for both nouns and verbs, whatever that solution might be.

7.2.3.1 Regularity in nominal arguments

The one argument that Dowty presents which somewhat supports an actual contrast between nouns and verbs involves nominal *by*-phrases. My understanding of Dowty's argument is that if nominal and verbal semantic argument structure really *are* different, and if nominal argument structure is more "regular" by virtue of being neo-Davidsonian and thus exhibiting more modifier-like properties, we ought to expect that the meanings of nominal arguments are more well-defined and less dependent on the noun than is the case with verbs. Dowty points out that the *by*-phrase is one such argument which exhibits this contrast. The distribution of *by*-phrases with event nouns is relatively limited. In particular, *by*-phrases do not cooccur with stative or non-stative, non-agentive event nouns:

(7.45a) Michael is loved by LaToya.
(7.45b) *the love of Michael by LaToya

(7.46a) Peace is hoped for by all people.
(7.46b) *the hope for peace by all people

(7.47a) The magician disappeared.
(7.47b) *the disappearance by the magician

Dowty attempts to relate this pattern to another use of nominal *by*-phrase modifiers, to indicate authorship or the consequence of some implied event:

(7.48a) a sonata by Mozart
(7.48b) Priscilla's child by Michael

Dowty's hypothesis is that for nouns, *by*-phrases must denote agency or causation. This relatively narrow meaning distinguishes them from verbal *by*-phrases, which can refer to a much wider range of thematic roles, as exemplified here in (7.45a) and (7.46a).

The relative regularity and transparency of nominal argument structure might also support Dowty's contention. As an example, let's consider verbs of verbal conflict, such as *debate*, *argue*, and *quarrel*. Some of these take PP complements headed by *about*, marking the topic of the dispute, such as *argue* and *quarrel*; some of these take NP objects, like *debate* and *argue*. All of these complements are optional:

(7.49a) I debated/argued/quarreled with LaToya.
(7.49b) I debated (*about) welfare policy with LaToya.
(7.49c) I argued (about) welfare policy with LaToya.
(7.49d) I quarreled *(about) welfare policy with LaToya.

The more semantically "transparent" of these complements is the *about*-complement, since it marks its relationship with the head explicitly.[8] When these verbs are nominalized, the argument structure gravitates toward the semantically transparent marking. NP objects of transitive verbs commonly map to *of*-complements in the corresponding nominalizations, yet neither *argument* nor *debate* is completely acceptable with *of*-objects. On the other hand, all the corresponding nominalizations feature *about*-complements, paralleling simple nouns like *article*:

(7.50a) my debate about/?of welfare policy with LaToya
(7.50b) my argument about/*of welfare policy with LaToya
(7.50c) my quarrel about/*of welfare policy with LaToya
(7.50d) an article about/*of welfare policy

So the complement structure of nouns seems to be more semantically transparent and regular than that of verbs.

However, these generalizations are only tendencies. Dowty's generalization about *by*-phrases admits the occasional *Recipient* instead of *Agent*:

(7.51) Any receipt of stolen goods by American citizens is illegal.[9]

And the contrast between *of* and *about* is not completely robust either. The noun *debate* is only questionable with an *of*-complement, and some simple nouns in this semantic class also permit *of*-complements which denote topics:

(7.52a) It's a story
of a man named Brady . . .
(7.52b) *A Tale of Two Cities*

I conclude that while the idea that there is something more "regular" about nominal argument structure has a great deal of truth to it, it's not at all clear that this tendency amounts to a formalizable contrast.

Actually, the same is true of Dowty's initial generalizations about nominal argument structure as well. For instance, he bases his initial contrast on the supposed optionality of nominal arguments. That is, since nominal arguments are both optional and regularized, they correspond more to adjuncts, and thus to neo-Davidsonian indexing. The validity of this analogy with modifiers depends crucially on both the optionality and regularity of nominal arguments. We just saw that the regularity of these arguments is subject to question; it turns out that the optionality of these arguments is questionable as well. Grimshaw (1990) has pointed out that if we focus on process nominalizations instead of result nominalizations (that is, nominalizations which refer to the event itself rather than its resulting state, effect or object), we find that nouns *do* take obligatory arguments. For instance, many nouns are ambiguous between a process reading and a result reading; so the nominalization *announcement* can denote the announcing event itself or what was announced. However, the sense of these nouns depends to a great extent on their array of arguments. With an *of*-phrase, *announcement* is most easily interpreted as the announcing event, while without the *of*-phrase, it unambiguously refers to the material announced:

(7.53a) LaToya's announcement of the Grammy winners

(7.53b) LaToya's announcement

So with respect to the process reading of *announcement*, the *of*-phrase is obligatory. This pattern can also be observed with nominalizations like *receipt*, which only have the process reading.[10] So alongside (7.51) above, we also have the ungrammatical (7.54):

(7.54) *Any receipt by American citizens is illegal.

This example is uninterpretable even on an attempted anaphoric reading of the material received.

So the initial motivations for Dowty's proposed nominal/verbal split seems fairly weak. Unfortunately for his proposal, his initial motivations will turn out to be the strongest argument. The other two arguments which Dowty puts forward, I think, do not support any contrast at all between nominal and verbal argument structure. With this preface in mind, I turn to Dowty's two primary observations.

7.2.3.2 Reference to events

Dowty argues that the properties of reference to events distinguish between nouns and verbs. Dowty cites the following data inspired by Sag (1985) and Fodor (p.c.):

(7.55a) John and Mary made an agreement yesterday. It was to perjure themselves.
(7.55b) John and Mary agreed yesterday. *It was to perjure themselves.

(7.56a) John gave Mary a warning then. It was to protect herself from puffins.
(7.56b) John warned Mary then. *It was to protect herself from puffins.

Dowty claims that these data show one way in which the anaphoric possibilities for nouns differs from the anaphoric possibilities for verbs. He acknowledges that events can be referred to by pronouns even when they are introduced verbally, but in these cases only modifiers are added, not arguments:

(7.57a) John kissed Mary. It occurred in the garden.
(7.57b) John kissed Mary. It took place in the afternoon.
(7.57c) John kissed Mary. It happened so quickly she couldn't object.

Dowty points out that all of the constituents which supply additional information about the anaphorically referred to event (*in the garden, in the afternoon, so quickly, ...*) are adjuncts. Dowty says these examples demonstrate the inability of verbally described events to tolerate augmentation of their participant structure via anaphora and justify the differential account of noun and verb semantics.

I don't think Dowty's argument holds together. As far as I can tell, Dowty is claiming that nouns differ from verbs in that nouns introduce events into the discourse to which participants can be later added, and verbs do not. How might this contrast be modeled? Apparently, events introduced by nouns must differ in some crucial way from events introduced by verbs. However, there seems to be little motivation for this contrast beyond the distinction Dowty describes. For instance, if verbal predicates are Davidsonian, there seems to be no reason to distinguish the events these predicates introduce from the events introduced by neo-Davidsonian nominal predicates, especially since there is a transparent mapping between the two representations. I demonstrated this mapping in the meaning postulate in (7.20), repeated here:

(7.20) $\Box\forall x\forall e[run'_{Davidsonian}(x)(e) \leftrightarrow$
$run'_{neoDavidsonian}(e) \wedge \theta_{SU,run'}(x)(e)]$

That is, even if Dowty is right, and nouns have different argument indexing properties than verbs, there is no reason to believe that the events introduced by verbal predicates would be incompatible with events introduced by nominal predicates, even if the nature of these two classes of predicates is fundamentally different.

So what is the source of the contrast Dowty observes? I will argue here that this supposed contrast is illusory. What Dowty fails to observe is that the successful reference in (7.55a) is not to an event, but to the product or result of the event. So the noun *agreement* in (7.55a) refers not to the act of agreeing, but to what was agreed upon. However, in (7.55b) there is no explicit mention of what was agreed upon; the content of the agreement would have been supplied by the surface object, if it were present. So the content of the agreement is explicitly mentioned in (7.55a), but not in (7.55b).

It is possible that this contrast, rather than the contrast between nouns and verbs, is responsible for the contrast Dowty observes. In fact, Sag and Pollard (1991) make exactly this argument. They observe that the content of the nominalizations in these examples is essentially equivalent to the content of the elided verbal object, and that if the object is not elided, reference succeeds:

(7.58a) *Kim promised Sandy. It was to support herself and her family.
(7.58b) Kim promised Sandy something. It was to support herself and her family.

It seems, then, that as long as the result of the event is explicitly mentioned, reference is possible.

If the contrast exemplified in (7.55) is a function of the explicitness of the event result and not due to the contrast between nouns and verbs, we ought to find that nouns which truly refer to events and fail to mention the event result don't support the reference pattern in (7.55a) any more than the verbs themselves do. And in fact, this is exactly what we find:

(7.59a) *Michael insisted. It was that LaToya be consulted.
(7.59b) Michael insisted on something. It was that LaToya be consulted.
(7.59c) *The producer ignored Michael's insistence. It was that LaToya be consulted.

Nominalizations of adjectives make this point even more clearly, since they seem almost always to denote the state or property that the adjective denotes, rather than some result or consequence of that state or property (whatever that might mean). The noun *awareness*, for instance, is as much about the state of being aware, and as litle about the content or target of that state, as the adjective *aware* is, and as expected, reference to that content fails when in the nominalization case:

(7.60a) Michael was aware. *It was that LaToya was lip-synching.
(7.60b) Michael was aware of something. It was that LaToya was lip-synching.
(7.60c) *Michael was uncomfortable with his awareness. It was that LaToya was lip-synching.

So Dowty's first contrast in reference possibilities has nothing to do with argument structure, but rather to what entities are introduced into the discourse, no matter what syntactic category introduces them.

Similarly, Dowty is incorrect about his generalizations about data of the form in (7.57). There is actually no prohibition against augmenting the participant structure of events introduced by verbs, either by introducing a new participant (as in (7.61a)) or by fleshing out already mentioned but underspecified role bearers (as in (7.61b)):

(7.61a) Mary was robbed, and John is the one who did it.
(7.61b) John finally beat somebody at tennis yesterday. In fact, he did it to somebody who deserved it.

Now, there are a number of ways to treat the resolution of the referent of *it* on the reading where both clauses in these examples describe the identical situation.[11] We can say that *it* refers directly to an entity (such as an event), or perhaps that *it* refers to a property (as in (7.61a)) or a relation (as in (7.61b)), and the event described is somehow taken as being codescriptive with the event described in the clause which "supplied" the antecedent for *it*. It does not really matter which model of event anaphora we choose; the result will be the same. In either case, we have contributed information about participants to a previously described event, one whose description is verbal rather than nominal. So we find that upon closer examination, Dowty's first argument actually offers no evidence which distinguishes between the argument structure of nouns and verbs.

7.2.3.3 Thematic uniqueness

Dowty's final observation requires some background. Consider a minimal event of washing e, for instance. This event has a single (complex or atomic) washer, and a single (complex or atomic) thing washed. Some theorists have hypothesized that this uniqueness of participants holds of all event participant slots.[12] We can express this condition in either order-based or role-based terms. In order-based terms, we require that events correspond to exactly one participant sequence:

(7.62) Uniqueness of participant sequences:
For all Davidsonian predicates R,
$\forall e \forall \vec{x}(R(\vec{x}, e) \rightarrow \forall \vec{y}(R(\vec{y}, e) \rightarrow \vec{x} = \vec{y}))$

In role-based terms, we require that no role in a given event is borne by more than one individual. Dowty calls this condition the *uniqueness of role bearers*:[13]

(7.63) Uniqueness of role-bearer:
For all thematic roles θ_i:
$\forall e \forall x \Box[\theta_i(x, e) \rightarrow \forall y[\theta_i(y, e) \rightarrow x = y]]$.

To derive a prediction from these uniqueness conditions, we must say something more than this, though. We must make the observation that syntactic arguments of predicates exhaustively describe the fillers of the semantic argument positions they correspond to. That is, if we utter (7.64), we may conclude that LaToya and Michael exhaustively enumerate the songwriters for the song in question:

(7.64) LaToya and Michael wrote a song.

I will not attempt to determine whether this conclusion is an quantity-based implicature or an entailment; I will assume the latter, since it is the more straightforward case.

Under this latter interpretation, we are claiming that the denotation of (7.64) is (7.65a) rather than (7.65b):

(7.65a) $\exists e[a'(song')(\lambda y[write'(y)(l+m)(e)])]$
(7.65b) $\exists e[a'(song')(\lambda y[\exists x(l+m \leq x \wedge write'(y)(x)(e))])]$

Together, these two principles conspire to predict that two event descriptions can only be codescriptive if the participants they propose are referentially identical. We can confirm this prediction by observing that the two sentences in (7.66) cannot jointly describe the event in (7.64):

(7.66) LaToya wrote a song. Michael wrote a song.

What Dowty intends is to exploit the uniqueness of role bearers to account for the following contrasts in the argument structure of event nouns:

(7.67a) the Romans' destruction of the city
(7.67b) the destruction of the city by the barbarians
(7.67c) *the Romans' destruction of the city by the barbarians

(7.68a) We witnessed an attack on the Sabines by the Romans.
(7.68b) We made an attack on the Sabines.
(7.68c) *We made an attack on the Sabines by the Romans.

(7.69a) I suffered a defeat.

(7.69b) I witnessed John's defeat.
(7.69c) *I suffered John's defeat.

Dowty argues that (7.67c) is syntactically unexceptional, and claims that its semantic deviance can be made to follow from (7.63). Similarly, *witness* differs from *make* and *suffer* in that the latter two predicates embody a relationship of participation between their subjects and the event referent of their NP objects, so we might expect these latter predicates, but not *witness*, to induce a thematic role clash.

Now, Dowty does not present this problem as a discriminator between nominal and verbal argument structure as much as as an observation about properties of nouns which are explicable by the principle of uniqueness of role bearers. However, it is clear from his discussion that he believes that the problem exemplified here is exclusively a problem for nominal argument structure. Not only do I disagree with Dowty's conviction here, but I think that exploring the nature of Dowty's misconception will further support parallels, rather than contrasts, between nominal and verbal argument structure.

The initial problem is that (7.63) doesn't really seem to be the right account of the badness of (7.67c). The uniqueness of role bearers only rules out situations where the same thematic role relates two NPs to the same event *when those NPs cannot be taken to be codescriptive.* That is, (7.63) says nothing about the case where two thematic role fillers referring to the same individual(s) modify a single noun. However, it turns out that these case are no better than (7.67c):

(7.70) *the Visigoths' destruction of the city by the barbarians

If the Visigoths and the barbarians are the same group of individuals, (7.63) fails to explain the badness of (7.70).

I believe that whatever explains the badness of (7.70) will immediately explain the badness of (7.67c). In particular, the restriction we seek for all these examples is one in which within a single sentence no two participant-denoting constituents (instead of individuals) bear the same thematic role to a single head. That is, the restriction we want is couched in terms of complement structure, rather than conditions on the model. So the contrast between these two restrictions parallels the contrast between the subcategorization-based and model-based entailments explored in the context of Carlson's discussion of *kick*.

Admittedly, this new condition is difficult to formalize; the constituents subject to this condition can be arguments such as *of*-phrases, modifiers like possessives, or superior arguments whose connection to the participant structure of the head is a consequence of the meaning of the matrix verb. This problem is intimately connected with what it means for a constituent to bear a thematic role to a head, a statement in which thematic roles range over grammatical objects (that is, constituents) instead of model-theoretic objects as they do in the formalization in Chapter 6. Nevertheless, it seems that this condition is on the right track. Note that it is both stronger and weaker than (7.63); while it imposes no global conditions on events, it imposes a more restrictive view within sentences, one which encompasses (7.70) as well as (7.67c).

Now that we've teased apart the thematic uniqueness of syntactic arguments from the thematic uniqueness of event participants, we can turn to the larger question of the parallels between nominal and verbal argument structure. First, there is no reason to believe that this new condition which accounts for (7.70) applies only to nominal argument structure. For example, it is trivially true of all the verbal neo-Davidsonian constituents we've described so far. Second, if we take a closer look at (7.63), we discover that its effects reveal substantial parallels between nominal and verbal argument structure. Recall that we've seen nothing *wrong* with (7.63); it just turns out to be the wrong account of (7.70). Furthermore, it overlaps with my alternative generalization to account for the badness of (7.67c), which both has multiple NPs bearing the same thematic role to the head within a single sentence and multiple participants bearing the same thematic role to the event. If we want to tease apart these two restrictions, we ought to look across sentence boundaries, where my alternative ought not to apply. And since (7.63) says nothing about nouns and verbs, event-denoting nouns and event-denoting verbs ought to exhibit the same behavior across S boundaries, if there is no difference between the semantics of the two. And this is exactly what we find.

Note first that no matter whether a noun or verb introduces the event and whether a noun or verb codescribes it, codescription is impossible when participant denotations clash:

(7.71a) *John finally beat his big brother at tennis yesterday. That's right, he beat his little sister. (verb introduces, verb refers)

(7.71b) *John finally beat his big brother at tennis yesterday. In fact, he did it to his little sister. (verb introduces, noun refers)
(7.71c) *We made an attack on the Romans yesterday. We attacked the Sabines at noon. (noun introduces, verb refers)
(7.71d) *We made an attack on the Sabines. It was by the Romans. (noun introduces, noun refers)

Here, the asterisk indicates the impossibility of codescription. The badness of all these cases follows immediately from the requirement that participants be unique.

Next, we can demonstrate that the positive side of the uniqueness constraint behaves in parallel ways across all four cases. If role fillers are codescriptive, events should be able to be as well:

(7.72a) Michael finally beat somebody at tennis yesterday. He beat LaToya. (verb introduces, verb refers)
(7.72b) Michael finally beat somebody at tennis yesterday. He did it to LaToya. (verb introduces, noun refers)
(7.72c) The doctor performed an operation on someone yesterday. He operated on Jermaine at noon. (noun introduces, verb refers)
(7.72d) The terrorists made an attack on someone yesterday. They did it to a group of defenseless civilians. (noun introduces, noun refers)

Finally, we must observe that order of introduction is important. As explicated by Heim (1982) and others, indefinites typically cannot be codescriptive with preceding NPs:

(7.73) *LaToya$_i$ entered. A musician$_i$ sat down.

So when the indefinite follows the proper noun and the possibility of coreference is eliminated, event codescription is not possible:[14]

(7.74a) *Michael finally beat LaToya yesterday. He beat somebody at tennis. (verb introduces, verb refers)
(7.74b) *Michael finally beat LaToya yesterday. He did it to someone in tennis. (verb introduces, noun refers)
(7.74c) *The doctor performed an operation on Jermaine yesterday. He operated on somebody at noon. (noun introduces, verb refers)
(7.74d) *The terrorists made an attack on a group of defenseless civilians. They did it to somebody at noon. (noun introduces, noun refers)

So what has this discussion of Dowty's proposal shown us? We've seen that the impact of the uniqueness of participants is independent of syntactic category, and that it conspires with principles of discourse interpretation to predict an array of coreference possibilities for events described both by nouns and by verbs. It is certainly possible to develop an account which distinguishes between nominal and verbal patterns here, but I cannot imagine why one might do so, since there is no motivation for it.

More important, we've seen no evidence at all which would justify the use of thematic roles in composition. None of the arguments of Parsons, Carlson or Dowty stand up to closer scrutiny. So if we want an argument which supports the compositional neo-Davidsonian alternative, we must look elsewhere. With this conclusion in mind, I turn to considerations of scope and distributivity.

7.3 Scope and distributivity

With respect to supporting a compositional neo-Davidsonian account, examining the conceptual status of arguments has turned out to be something of a dry well. In this section, I turn to the other major difference between Davidsonian and neo-Davidsonian composition, namely the relationship between scope, arguments and distributivity. The principal players in this area are Lasersohn (1988; 1993; 1995) and Schein (1994). We will see that this difference as well fails to support a neo-Davidsonian compositional semantics.

7.3.1 Scope and argument independence

We can show that the neo-Davidsonian account admits possibilities which are unavailable in the Davidsonian account, because thematic roles allow arguments to be referenced independently of one another. Let me illustrate this contrast by contrasting the derivation of a sentence involving two generalized quantifiers and a transitive verb in the Davidsonian and neo-Davidsonian frameworks:

(7.75) Davidsonian:

$$\overline{\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP}),\ \mathcal{D}_{SU}} \quad \overline{(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP},\ R_1} \quad \overline{\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP}),\ \mathcal{D}_{DO}}$$

$$\overline{\textbf{AR}\text{: } (\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})),\ \lambda\mathcal{D}\lambda x[\mathcal{D}(\lambda y\lambda e[R_1(y)(x)(e)])]}$$

$$\overline{\textbf{FA}\text{: } \mathrm{V}/_{\mathrm{L}}\mathrm{NP},\ \lambda x[\mathcal{D}_{DO}(\lambda y\lambda e[R_1(y)(x)(e)])]}$$

$$\overline{\textbf{FA}\text{: } \mathrm{V},\ \mathcal{D}_{SU}(\lambda x[\mathcal{D}_{DO}(\lambda y\lambda e[R_1(y)(x)(e)])])}$$

(7.76) neo-Davidsonian:

$$\overline{\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP}),\ \mathcal{D}_{SU}} \quad \overline{(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP},\ \langle P_1, [\Gamma(\theta_{SU,P_1}), \Gamma(\theta_{DO,P_1})]\rangle} \quad \overline{\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP}),\ \mathcal{D}_{DO}}$$

$$\overline{\textbf{(6.37)}\text{: } (\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})),\ \langle P_1, [\lambda\mathcal{D}\lambda P[\mathcal{D}(\lambda y[\Gamma(\theta_{DO,P_1})(y)(P)])], \Gamma(\theta_{SU,P_1})]\rangle}$$

$$\overline{\textbf{(6.35)}\text{: } \mathrm{V}/_{\mathrm{L}}\mathrm{NP},\ \langle \mathcal{D}_{DO}(\lambda y[\Gamma(\theta_{DO,P_1})(y)(P_1)]), [\Gamma(\theta_{SU,P_1})]\rangle}$$

$$\overline{\textbf{(6.37)}\text{: } \mathrm{V}/_{\mathrm{L}}(\mathrm{V}/_{\mathrm{R}}(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})),\ \langle \mathcal{D}_{DO}(\lambda y[\Gamma(\theta_{DO,P_1})(y)(P_1)]), [\lambda\mathcal{D}\lambda P[\mathcal{D}(\lambda x[\Gamma(\theta_{SU,P_1})(x)(P)])]]\rangle}$$

$$\overline{\textbf{(6.36)}\text{: } \mathrm{V},\ \mathcal{D}_{SU}(\lambda x[\Gamma(\theta_{SU,P_1})(x)(\mathcal{D}_{DO}(\lambda y[\Gamma(\theta_{DO,P_1})(y)(P_1)]))])}$$

The final interpretation of the neo-Davidsonian case reduces as follows:

$$\begin{aligned}
(7.77)\ & \mathcal{D}_{SU}(\lambda x[\Gamma(\theta_{SU,P_1})(x)(\mathcal{D}_{DO}(\lambda y[\Gamma(\theta_{DO,P_1})(y)(P_1)]))]) = \\
& \mathcal{D}_{SU}(\lambda x[\lambda\theta\lambda x\lambda P\lambda e[P(e) \wedge \\
& \quad \theta(x)(e)](\theta_{SU,P_1})(x)(\mathcal{D}_{DO}(\lambda y[\Gamma(\theta_{DO,P_1})(y)(P_1)]))]) = \\
& \mathcal{D}_{SU}(\lambda x\lambda e[\mathcal{D}_{DO}(\lambda y[\Gamma(\theta_{DO,P_1})(y)(P_1)])(e) \wedge \theta_{SU,P_1}(x)(e)]) = \\
& \mathcal{D}_{SU}(\lambda x\lambda e[\mathcal{D}_{DO}(\lambda y[\lambda\theta\lambda y\lambda P\lambda e'[P(e') \wedge \\
& \quad \theta(y)(e')](\theta_{DO,P_1})(y)(P_1)])(e) \wedge \theta_{SU,P_1}(x)(e)]) = \\
& \mathcal{D}_{SU}(\lambda x\lambda e[\mathcal{D}_{DO}(\lambda y\lambda e'[P_1(e') \wedge \\
& \quad \theta_{DO,P_1}(y)(e')])(e) \wedge \theta_{SU,P_1}(x)(e)])
\end{aligned}$$

In order to illustrate the contrast better, I will place the final interpretations side by side and rearrange the conjuncts in the final formula in (7.77). I will indicate the elements corresponding to the logical subject with a single underline, and those corresponding to the logical object with a double underline:

(7.78a) Davidsonian:

$$\underline{\mathcal{D}_{SU}}(\lambda \underline{x}[\underline{\underline{\mathcal{D}_{DO}}}(\lambda \underline{\underline{y}}\lambda e[R_1(\underline{\underline{y}})(\underline{x})(e)])])$$

(7.78b) neo-Davidsonian:

$$\underline{\mathcal{D}_{SU}}(\lambda \underline{x}\lambda e[\theta_{SU,P_1}(\underline{x})(e) \wedge \underline{\underline{\mathcal{D}_{DO}}}(\lambda \underline{\underline{y}}\lambda e'[P_1(e') \wedge \theta_{DO,P_1}(\underline{\underline{y}})(e')])(e)])$$

Notice that in (7.78a), the argument x bound by the subject generalized quantifier $\mathcal{D}_{SU}$ is referred to within the scope of the direct object generalized quantifier $\mathcal{D}_{DO}$, in (7.78b), there is no such reference to the logical subject within the scope of the object. What difference might this contrast lead to?[15]

I think the question boils down to what the logical subject of e' is in (7.78b). There is one event variable in (7.78a), and its logical subject and object positions are filled. In (7.78b), on the other hand, there are two event variables, e and e'; the logical subject of e is x, bound by the subject generalized quantifier, but the logical subject of e' is not mentioned. And since it's not mentioned, it can differ from the logical subject of e.[16] This degree of variation is not possible in the Davidsonian case in (7.78a), since only one event variable is mentioned. So if we can find a configuration which allows e and e' to differ and show that the contrast favors the neo-Davidsonian case, we have an argument for neo-Davidsonian composition. Since it is the direct object generalized quantifier $\mathcal{D}_{DO}$ which binds e' and takes e as an argument, I will concentrate on values of $\mathcal{D}_{DO}$ which might enable this contrast.

We can begin by observing that $\mathcal{D}_{DO}$ cannot correspond to existential quantification. Consider a representative meaning:

(7.79) $\mathcal{D}_{DO} = \lambda E \lambda e[\exists x(P(x) \wedge E(x)(e))]$

For any Davidsonian VP E and CN denotation P, $\mathcal{D}_{DO}(E)$ is that set of events which is produced by applying E to some element of P. In other words, it is a subset of the projection of E on its second coordinate. So any event argument of $\mathcal{D}_{DO}$ will automatically be an event argument of E, and e and e' will not differ under existential quantification, and no difference between the Davidsonian and neo-Davidsonian cases will arise. For the same reason, if $\mathcal{D}_{DO}$ corresponds to a type-raised individual, no difference between the Davidsonian and neo-Davidsonian cases will arise there either.

However, consider the possibility that $\mathcal{D}_{DO}$ corresponds to a universal quantifier. Consider, for instance, the meaning of *every* P for some CN P, using the definition of *every* from (5.45):

(7.80) $[\![\text{every P}]\!] =$
$$\lambda E[MinPred(\lambda e[\forall x(P(x) \rightarrow \exists e'(e' \leq e \wedge E(x)(e')))])]$$

For any set of individuals V, the set $MinPred(V)$ is the set of minimal elements of V and thus a subset of V; so fillers of the event argument of $[\![\text{every P}]\!](E)$ are to be found among the individuals bound to e in (7.80). However, the event argument of E is e', which is a part of e and not identical to it. So the case of universal direct object generalized quantifiers might provide a test which distinguishes between Davidsonian and neo-Davidsonian accounts.

So what will the logical subject of e' be in the neo-Davidsonian case? If e' is a part of e, and summativity applies to thematic roles as proposed in Chapter 6, then the logical subject of e' will be a part of the logical subject of e; that is, it will be some part of x in (7.78b). This observation leads to a final condition on the relevant examples which might distinguish between the two accounts. In order for the nonidentity of e and e' to make any difference, we must have some evidence of the difference. If x is atomic, the only part of x is x itself; so if we want to observe a difference in participants based on the difference between events, we have to look at nonatomic instantiations of x.

So the circumstances under which the difference between Davidsonian and neo-Davidsonian participation can lead to a potential meaning contrast are extremely limited. In the simple transitive case, we need a construction which contains a plural surface subject (so the logical subject of e' has an opportunity to differ from it) and a nonsubject distributive determiner (so that the events within its scope are not necessarily the events it binds). We will see that this situation does arise; however, it will fail to favor the neo-Davidsonian alternative.

7.3.2 *Lasersohn (1993)*

I argued a moment ago that object existentials cannot induce the sort of scope relationships which have the potential to choose between the Davidsonian and neo-Davidsonian compositional strategies. It will be illuminating, then, to examine an argument which attempts to use data of exactly this form to argue for neo-Davidsonian composition. As I predicted, this argument will fail, but the reasons for its failure will be illustrative.

In Chapter 3, I proposed that summativity applies as a condition on the denotation of all lexical relation-denoting expressions. I repeat the definition of summativity here:

(3.58) Summativity: for all relation denotations R of lexical items,
$$R(x_1, \ldots, x_n) \wedge R(y_1, \ldots, y_n) \rightarrow R(x_1 + y_1, \ldots, x_n + y_n)$$

However, summativity is only a partial description of the atomicity conditions on the elements of these denotations. We also observed that some predicates, like *sleep*, are distributive, others, like *meet*, are collective, and still others, like *wash*, are neither. However, although I demonstrated that a Davidsonian account can distinguish between true collective participation and summed distributive participation, I did not provide a "definition" of distributivity or collectivity. I will follow Lasersohn (1993; 1995) in encoding these definitions as entailments on predicates. I will concern myself only with distributivity in the discussion to follow. I'll illustrate with a condition on the meaning of *sleep*, in the form of a meaning postulate:

(7.81)
$$\Box\forall x\forall e(sleep'(x)(e) \rightarrow \forall y((y \leq x \wedge y \in At) \rightarrow \exists e'(e' \leq e \wedge sleep'(y)(e'))))$$

That is, it is necessarily true of the denotation of *sleep* that if e is an event of some individual sleeping, then every atomic part of that individual sleeps in some subevent of e. This condition is trivially satisfied if the sleeper in e is already atomic; however, it requires that any sleeping by nonatoms decompose into sleeping by atoms. So if Michael and LaToya sleep, then Michael sleeps and LaToya sleeps. In some sense, this condition is the inverse of the requirement of summativity; summativity tells us how the denotation must be built up, and the distributivity entailment tells us how the denotation must be able to be decomposed.

But how are distributivity entailments encoded in predicates with more than one participant? It's possible for a predicate to be distributive in one argument but not the other. The example Lasersohn (1993) uses is the predicate *kill*. Let's assume that if a group is killed, then every member of the group is killed, but if a group kills, then it's not necessarily the case that every member of the group kills. That is, being killed is distributive, but doing the killing is not. The terms in which this condition is encoded is one of the issues which Lasersohn (1993) addresses.

Lasersohn is concerned with the interaction between passive, plurals, and the sorts of distributivity entailments I've just described. Lasersohn's account of Agentless Passive is exactly the one illustrated in (7.14) above, in which the logical subject argument is existentially closed. Notice that Lasersohn (1993) adopts an eventless semantics for the purposes of his discussion:

(7.82a) LaToya was killed.
(7.82b) $\exists x(kill'(l)(x))$

The key to Lasersohn's argument lies in the idea that whatever meaning postulates hold of $kill'$ must hold within the scope of this existential quantifier. The particular interaction Lasersohn considers is the one between plurals and meaning postulates for distributivity. Lasersohn proposes that we need a definition of distributivity with respect to a given argument place, and makes the following initial prediction:

(7.83) α is distributive at argument position i iff whenever x_i is plural,
$$\forall x_1, \ldots, x_n(\alpha(x_1, \ldots, x_i, \ldots, x_n) \leftrightarrow \forall y((At(y) \wedge y \leq x_i) \rightarrow \alpha(x_1, \ldots, y, \ldots, x_n)))$$

In other words, given a plural individual at argument position i, for every atom in that plural, the predicate in question can be predicated of it *with all other arguments held constant.* This last condition will figure prominently in Lasersohn's argument.

So for *kill*, which we've observed is distributive on its second argument position, we end up with the meaning postulate in (7.84):

(7.84) $\Box\forall x\forall y(kill'(y)(x) \rightarrow \forall z((z \in At \wedge z \leq y) \rightarrow kill'(z)(x)))$

Now, let's consider a passive with a plural surface subject:

(7.85) $[\![\text{Two musicians were killed}]\!] =$
$$\exists y\exists x(musicians'(y) \wedge |y| = 2 \wedge kill'(y)(x))$$

But (7.84) and (7.85) together entail that the same individual killed both musicians:

(7.86) $\exists y \exists x(musicians'(y) \wedge |y| = 2 \wedge$
$\forall z((z \in At \wedge z \leq y) \rightarrow kill'(z)(x)))$

Lasersohn argues that if thematic roles were used to index arguments instead of order, the existential quantification over the missing argument would not be necessary.

After briefly considering and rejecting another eventless version of his lexical distributivity schema, Lasersohn proposes the following neo-Davidsonian account:

(7.87) α is distributive with respect to thematic role θ iff:
$\forall e \forall x((\alpha(e) \wedge \theta(x)(e)) \leftrightarrow \forall y((y \in At \wedge y \leq x) \rightarrow$
$\exists e'(e' \leq e \wedge \theta(y)(e'))))$

Now let's see what happens when we don't have to refer to the subject argument:

(7.88a) Two musicians were killed.
(7.88b) $\lambda e[\exists x(musicians'(x) \wedge |x| = 2 \wedge kill'(e) \wedge killee'(x)(e))$

If we know that $kill'$ is distributive with respect to $killee'$, then by (7.87), every atomic part of the individual killed in e is an individual killed in a subevent of e. No commitments are made about who did the killing; more disturbingly, no commitment is made that there are any killers at all. In order to remedy this latter problem, Lasersohn adopts the Carlson-style meaning postulates for enforcing the presence of participants, but with a twist. He requires these generalizations to hold only of atomic events. I will use my $MinPred$ relation to encode this requirement:

(7.89) $\forall e(MinPred(kill')(e) \rightarrow \exists x(killer'(x)(e)))$

One might think that this condition on atomicity is superfluous. The problem which Lasersohn identifies with the ordered argument account is that in (7.86), the same individual must kill both musicians. However, this problem is avoided entirely in the neo-Davidsonian account; even if we require that all killings, even nonatomic ones, have killers, the killers in the subevents of the complex event in (7.88) need not be the same killers assigned to the complex event itself, and the problem manifested in the ordered argument account does not arise. That is, it is the independence of arguments in the neo-Davidsonian account, rather than the atomicity of (7.89), that allows us to escape from the problematic interaction of distributivity and passive which Lasersohn observes. However, Lasersohn has other plausible reasons for imposing the atomicity requirement, which we will see shortly.

Lasersohn is certainly right that the neo-Davidsonian account does away with reference to the logical subject in the passive case; however, this is by no means the only way to address this issue. The problem lies not in the classical, order-based account, but rather in Lasersohn's assumptions.

The fundamental problem is that (7.84) is wrong. Recall that Lasersohn's initial definition of distributivity at an argument position holds all other arguments constant. The result is that (7.84) requires that if some nonatomic individual is killed by someone, then every atomic part of that individual is killed by the same someone. But that's not right. Think back to summativity again. If summativity holds, then if LaToya kills Jermaine and Janet kills Michael, then LaToya and Janet kill Jermaine and Michael, which seems right. But then the object position of $kill'$ is not distributive according to (7.84), because we can't hold the subject constant as we decompose the nonatomic object. In other words, the individual which kills Jermaine and Michael is not the individual which kills Jermaine, or the individual which kills Michael.[17] In fact, if summativity holds, any argument position is susceptible to the same objection. So for any predicate to which summativity applies, (7.84) is immediately ruled out as a possible account of distributivity in an ordered-argument account.

I conclude that it's not right to hold the other arguments constant when we define distributivity entailments. Lasersohn does indeed consider the obvious alternative, namely that if a nonatomic individual is killed by someone, then its atomic parts are killed by parts of that someone. Lasersohn attributes a version of this proposal to Barry Schein; my attempt at defining such a meaning postulate is found in (7.90). I will require that if an individual is killed, either that individual is atomic or it decomposes into nonoverlapping parts which are killed by some part of the overall killer. This definition has the effect of requiring that all nonatomic individuals killed ultimately decompose into atoms, while also reflecting the summativity requirement on the killer:

$$(7.90)\ \Box\forall x\forall y(\mathit{kill}'(y)(x) \rightarrow y \in At \vee \exists x_1\exists x_2\exists y_1\exists y_2(\mathit{kill}'(y_1)(x_1) \wedge \mathit{kill}'(y_2)(x_2) \wedge x = x_1 + x_2 \wedge \neg\exists z(z \leq y_1 \wedge z \leq y_2) \wedge y = y_1 + y_2))$$

So if Jermaine and Michael are killed by killer x, then Jermaine is killed by some part of killer x and Michael is killed by some other part of killer x. My original discussion of scope and quantification leads us to expect this alternative: as long as we assume summativity, existential quantification by itself cannot induce a case which chooses between Davidsonian and neo-Davidsonian (or even classical and neo-Davidsonian) composition strategies.

In order for this account to work, the interpretation of agentless passives must be equivalent to the interpretation of agentive passives with existentially quantified agents, because of the existential closure properties of passive in an ordered-argument account. That is, if *X were killed* is true because a group of elements of the CN *P* summatively killed the group *X*, then *X were killed by Ps* must also be true, and vice versa. Lasersohn argues that this account cannot be right, because there are some predicates which do not behave in this way. Here's what he says:

> Consider the verb *know*, for instance, as in *to know a song*. This verb is distributive in its object argument place; you can't know some songs unless you know the individual songs themselves. However, *know* does not allow, as a matter of general principle, the kind of "gathering up" in subject position that we saw with *kill*. Consider the following context: John is organizing a children's pageant, in which a group of children are supposed to perform various songs. Some of the children may know some of the songs, and others of the children may know others of the songs, and still more of the children may know the rest – so that every song is known by at least some of the children; but unless all the children know all the songs they are supposed to,. . . , John cannot truthfully assert [that *The children know the songs*.] One cannot, as a matter of general principle, freely gather up the individuals that know subsets of the songs, put them all in a group, and say of the group that it knows the songs. (p. 155)

So *The children know the songs* exhibits some requirement of "supposed to"-ness which holds between the children and the songs. This relation is also present in the agentive passive *The songs are known by the children.* However, this requirement vanishes in the agentless passive; *The songs are known* means that each of the songs are known, without implying that the knowers are the ones who are supposed to know the songs. Since the agentive agentless passives differ in their interpretations, Lasersohn concludes that the type of meaning postulate exemplified in (7.90) cannot account for the distributivity of the object position of *know*.

Schein counters that we might interpret *the songs* contextually as *the songs they were supposed to know*, or something along those lines, and interpret *The children know the songs* distributively, so *The children know the songs* ends up meaning that each child knows the songs that child was supposed to know, which seems about right. This proposal has problems covering the data already presented; for instance, Lasersohn's point is that *The songs are known* does not have the requirement of "supposed to"-ness that *The children know the songs* does, and Schein's counterproposal, as reported by Lasersohn, gives no reason why *the songs* is not interpreted as *the songs they were supposed to know* in the agentless passive as well as the active. Lasersohn himself raises another problem:

> ...Suppose that the songs involve fairly complex choral arrangements where the different children sing different parts, even of a given song. In this case, [*The children know the songs*] can be true even if no child actually knows a whole song, as long as they each know their parts. Should we now claim that *the songs* may be contextually interpreted as *those portions of the songs they are supposed to*? In my opinion, this would go just too far in allowing a contextual effect on the compositional semantics of the noun phrase,...(p. 156)

Lasersohn's account, on the other hand, crucially distinguishes between complex and atomic events. While it is true that every atomic knowing has a knower and a thing known, parallel to *kill′* in (7.89), no such requirement holds of nonatomic knowings, such as the one in *The songs are known*. So if the relation of "supposed to"-ness holds between knowers and things known for knowing events, it will hold either when both arguments are explicit or when the event is atomic, but not of an atomic event which only specifies the things known. This account predicts that agentive passive *The songs are known by the children* parallels the active in exhibiting "supposed to"-ness, but the agentless passive will not.

If Lasersohn is right that an order-based account makes too strong a claim about the relationship between passive and active, then we have some reason to believe a role-based account. However, I think Lasersohn is mistaken on the facts, and we will see that not only does the correct account eliminate the advantage of the role-based account, it also compromises the justification for Lasersohn's atomicity condition on participant requirements.

Although Schein does not explain why the agentless passive does not exhibit the "supposed to"-ness requirement, I think that he is on exactly the right track about *know*, and in fact Lasersohn's objection is muddied by the interaction of plurals and summativity. If I approach one of the children in the pageant, and I ask that child how thoroughly he or she has practiced, that child might reply:

(7.91) I know the songs in the first act.

If this child only sings in some of the songs in the first act, the child can still utter (7.91) truthfully. In other words, "supposed to"-ness is implicit in this particular use of *know*, even when the subject is singular, just as Schein proposes.

A similar reply can be made to Lasersohn's second objection. Let's say Jermaine is auditioning for a barbershop quartet as a baritone. He is asked what song he wants to sing with the quartet for his audition, and he replies in (7.92):

(7.92) I know *Blue Moon*.

There is no reason to conclude, given (7.92), that Jermaine knows any part of *Blue Moon* other than the baritone part. That is, somehow *know* must be contextually interpreted as referring to specific portions of the overall object which is said to be known. In other words, the sort of contextualization Lasersohn cannot bring himself to embrace happens quite naturally, and plurals and distributivity are not the problem with *know*.

Furthermore, in order for Lasersohn's argument to have any force, the relation of "supposed to"-ness must be part of the meaning of *know*. However, we can easily construct a context in which the requirements on *know* are no more strict than the requirements on *kill*. In (7.93), for instance, there is no requirement that my British friends are supposed to know any songs, or even that they know more than one song apiece:

(7.93) My British friends know lots of drinking songs.

I would argue, in fact, that the relation of "supposed to"-ness evident in Lasersohn's crucial example is entirely a function of the definiteness of the object NP determiner. If we provide a list of songs, or provide an indefinite determiner, the requirement of "supposed to"-ness vanishes:

(7.94a) The children know *Blue Moon* and *The Star Spangled Banner.*
(7.94b) The children know some songs.

Thus, this relation of "supposed to"-ness cannot be part of the meaning of *know*.

Finally, let's return to Lasersohn's atomicity-based account of the difference between the agentive *The children know the songs* and the agentless *The songs are known*. Lasersohn claims that the contrast is explained by the absence of a requirement that the complex event *The songs are known* have a single (possibly complex) knower, and since there is no knower, there can be no relation of "supposed to"-ness between the knower and the songs. We've already seen that this relation of "supposed to"-ness cannot be part of the semantics of *know*; let's consider the alternative possibility that it's part of the non-truth-conditional meaning of *know* in some way, part of the pragmatics. If this pragmatic relation is keyed on the presence of a knower, Lasersohn's account (whether semantic or pragmatic) predicts such a contrast *only* in complex events; for atomic events, the passive and the active ought to mean the same thing. However, (7.92) above, which describes an atomic event, contrasts with its agentless passive in a very similar way:

(7.95) *Blue Moon* is known.

As far as I can tell, (7.95) cannot mean (or imply) that whoever is the knower in question knows just the baritone part, as the active can; but since both the event in (7.95) and the event in (7.92) are atomic, they each have a knower and a thing known, and whatever pragmatic distinctions which are keyed on the presence of a knower cannot distinguish between the two. While this is not the same pragmatic inference as found in *The children know the songs*, its behavior with respect to the contrast between active and agentless passive parallels the case of complex events. To my mind, this observation, together with the observation in (7.94), compromises Lasersohn's atomicity requirement rather seriously; since we've seen that "supposed to"-ness relation, when it's present at all, can be attributed to the definiteness of the object rather than the meaning of the verb, and since we have strongly parallel properties of pragmatic accommodation in the atomic as well as the nonatomic case, the motivation for the atomicity requirement seems to have pretty much evaporated. The nature of the pragmatic accommodation itself remains a mystery; but its behavior suggests strongly that it has nothing to do with the contrast between role-based and order-based accounts of distributivity.

So a careful examination of Lasersohn's argument is consonant with a number of aspects of our discussion so far. As predicted, inner-scope existentials do not induce a situation which might distinguish between Davidsonian and neo-Davidsonian composition. In demonstrating this result, we saw some of the same issues that Parsons, Carlson and Dowty wrestled with. In the final analysis, Lasersohn falls prey to the temptation to provide an event-based account of a phenomenon which turns out to be much more a property of variation of surface argument structure, just as Carlson does in Section 7.2.2.2 and Dowty does in Section 7.2.3.3. So far, then, the attempt to prove the usefulness of neo-Davidsonian composition has faltered repeatedly on the same issues, and demonstrated how truly hard it is to find a compositional advantage to the sort of argument independence that neo-Davidsonian composition affords. *know*

7.3.3 Nonsubject distributivity

The problem with Lasersohn's argument is that it is an argument about lexical entailments rather than surface arguments. However, there is a similar argument which has exactly the right properties, put forward by Schein (1994) and supported by Bayer (1994). I will argue here that while the constructions considered are exactly those which might choose between Davidsonian and neo-Davidsonian semantics, they do not favor the neo-Davidsonian alternative.

The basic problem with Lasersohn's data is that it involves existential instead of distributive inner quantification. The cases which we will discuss here involve plural subjects with distributive objects. Let's return to (3.55a) again:

(3.55a) Michael and LaToya/two people washed ten cars.

We noted in Chapter 3 (and commented again in Section 7.3.1 above) that the "neutral" interpretation of this example is supported by the properties of summativity, together with a view of unmodified cardinal numbers as existential quantification over plural individuals of the appropriate size. So if Michael washes six cars and LaToya washes four, the denotation of *wash* will contain a complex event which is the sum of these ten washings, whose washer is the nonatomic individual corresponding to the group of Michael and LaToya and whose thing washed is the group of the ten cars.

Now assume that these ten cars are exactly the cars in the driveway, and consider (7.96):

(7.96) Michael and LaToya/two people washed every car in the driveway.

This example has a neutral reading as well, which describes a situation which is also describable by (3.55a). That is, two people wash cars, and every car in the driveway is washed, but no commitments are made about which people (individually or jointly) washed which cars. Now compare the interpretation of (7.96) under the Davidsonian interpretation in (7.75) and the neo-Davidsonian interpretation in (7.77). We will instantiate the elements in these abstractions as follows:

(7.97a) $\mathcal{D}_{SU} = [\![\text{two people}]\!] =$
$\lambda E \lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge E(x)(e))]$
(7.97b) $\mathcal{D}_{DO} = [\![\text{every car}]\!] =$
$\lambda E[MinPred(\lambda e[\forall y(car'(y) \rightarrow \exists e'(e' \leq e \wedge E(y)(e')))])]$
(7.97c) $R_1 = wash'_{Davidsonian}$
(7.97d) $P_1 = wash'_{neoDavidsonian}$
(7.97e) $\theta_{SU,P_1} = washer'$
(7.97f) $\theta_{DO,P_1} = washee'$

Here's what we get:

(7.98) Davidsonian:
$\mathcal{D}_{SU}(\lambda x[\mathcal{D}_{DO}(\lambda y \lambda e[R_1(y)(x)(e)])]) =$
$\lambda E \lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge$
$E(x)(e))](\lambda x[\lambda E[MinPred(\lambda e[\forall y(car'(y) \rightarrow$
$\exists e'(e' \leq e \wedge E(y)(e')))])](\lambda y \lambda e[wash'(y)(x)(e)])]) =$
$\lambda E \lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge$
$E(x)(e))](\lambda x[MinPred(\lambda e[\forall y(car'(y) \rightarrow$
$\exists e'(e' \leq e \wedge wash'(y)(x)(e')))])]) =$

$$\lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge$$
$$MinPred(\lambda e''[\forall y(car'(y) \rightarrow$$
$$\exists e'(e' \leq e'' \wedge wash'(y)(x)(e')))])(e))]$$

(7.99) neo-Davidsonian:

$$\mathcal{D}_{SU}(\lambda x \lambda e[\mathcal{D}_{DO}(\lambda y \lambda e'[P_1(e') \wedge$$
$$\theta_{DO,P_1}(y)(e')])(e) \wedge \theta_{SU,P_1}(x)(e)]) =$$
$$\lambda E \lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge E(x)(e))]$$
$$(\lambda x \lambda e[\lambda E[MinPred(\lambda e[\forall y(car'(y) \rightarrow$$
$$\exists e'(e' \leq e \wedge E(y)(e')))])]$$
$$(\lambda y \lambda e'[wash'(e') \wedge washee'(y)(e')])(e) \wedge$$
$$washer'(x)(e)]) =$$
$$\lambda E \lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge$$
$$E(x)(e))](\lambda x \lambda e[MinPred(\lambda e[\forall y(car'(y) \rightarrow$$
$$\exists e'(e' \leq e \wedge wash'(e') \wedge washee'(y)(e')))])(e) \wedge$$
$$washer'(x)(e)]) =$$
$$\lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge MinPred(\lambda e[\forall y(car'(y) \rightarrow$$
$$\exists e'(e' \leq e \wedge wash'(e') \wedge washee'(y)(e')))])(e) \wedge$$
$$washer'(x)(e))]$$

These examples contrast in exactly the way sketched in Section 7.3.1. In the neo-Davidsonian case, the two people are the complex washer of a complex event which is the minimal sum of every car being washed. In the Davidsonian case, on the other hand, the two people are the complex washer of each car. The Davidsonian reading, which I will call the *team* reading, seems inappropriate for the neutral reading of (7.96), while the neo-Davidsonian reading seems exactly right. Schein's term for the neutrality of this neo-Davidsonian reading is *essential separation*; while his exposition and analysis differ from mine, due to his differing view of plurals, the basic point is the same.

Here, then, is an apparent argument for neo-Davidsonian composition. It has all the right properties. Does it stand up to scrutiny? I will argue that it does not. In the sections to follow, I will discuss the problem in more detail, present alternative solutions, and demonstrate that the neo-Davidsonian advantage is only apparent.

7.3.3.1 Ruling out nondistributivity

What makes this argument work is the lexical distributivity of *every*. In the case of a constituent which corresponds to an individual or to existential quantification, a single (possibly nonatomic) element is introduced as a participant. If summativity applies to the lexical meaning of the verb, any single complex participant has the potential of corresponding to a complex event whose internal distribution with respect to subevents is undetermined by the surface syntax or semantic composition:

(7.100) $[\![$Janet and Michael wrote two songs$]\!] =$
$\exists e \exists x(song'(x) \wedge |x| = 2 \wedge write'(x)(j + m))$

So Janet and Michael could have cowritten each song; Janet could have written one and Michael the other; etc.

On the other hand, a lexically distributive determiner like *every* poses a distinct disadvantage in neutral readings, because imposes requirements on the internal structure of the complex event; since every atomic individual in the complex event is mentioned, every atomic event is mentioned as well. If we mention every atomic individual and every event, we somehow need to "mimic" the individual/existential case, doing in the semantic composition what summativity does in the Davidsonian verbal denotation. In other words, our goal is to somehow create a single, complex event and a single, complex participant out of the individual mentions which arise from lexical distributivity.

But in order to sum up a given argument to mimic summativity, each argument position has to be summed independently, because the relation between the individuals holds explicitly only among the summed individuals, not among their parts. So in order to do this appropriately, we need to avoid referring to the other arguments which are already complex individuals, because we only want to "look" at them once the summation is complete. The most straightforward way to do this is to guarantee that every participant position be "mentionable" independently of every other position, so that we can sum up the occupants of that argument position without worrying about the interactions of this operation with other participants. It is specifically those undesirable interactions that give us the team reading in the Davidsonian case, and the independent nature of the arguments which gives us the appropriate neutral reading in the neo-Davidsonian case.

So minimally, the support for a neo-Davidsonian analysis embodied in this argument relies on the distributive nature of *every*. One potential reply, then, might be that *every* isn't distributive in (7.96). It's got nothing within its scope to prove that it's distributive; maybe *every* is ambiguous between a distributive reading and one where it denotes the maximal individual corresponding to the CN. This proposal is in fact made in Landman (1993, p. 65). On this individual-denoting reading, *every car* refers to an individual which is the join of all the elements of the set of cars. I will borrow the σ operator from Link (1983) and Ojeda (1991) for this purpose. Then the Davidsonian interpretation of (7.96) would be something like this:

(7.101) $\lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge wash'(\sigma z[car'(z)])(x)(e))]$

This interpretation is consistent with the neutral reading we seek, so perhaps we can address the apparent shortcomings of the Davidsonian account this way.

Unfortunately, there are a number of problems with making *every* individual-denoting. First, there are a number of situations in which this sense of *every* may not occur. For instance, in subject position, when there is a possibility of ambiguity, *every* is unambiguously distributive:

(7.102) Every boy washed a car.
($\neq \lambda e[\exists y(car'(y) \wedge MinPred(wash')(y)(\sigma z[boy'(z)])(e))]$[18])

(7.103) Every boy wrote the story.
($\neq \lambda e[MinPred(write')(the\text{-}story')(\sigma z[boy'(z)])(e)]$)

That is, (7.102) cannot mean that a group consisting of all boys performed a single car-washing event, and (7.103) cannot mean that a group consisting of all boys cooperatively wrote the story in question.[19]

The nature of this restriction extends beyond subject position. If all the other NPs are atomic individuals, nonsubject occurrences of *every* are also prohibited from exhibiting the group reading. For example, if Michael stands next to the musicians in his band, he may be standing next to the bass player but not next to the guitarist. That is, it's possible to stand next to a group without standing next to every member in that group. On its proposed individual-denoting reading, *every P* denotes the summation of all relevant elements of P; *the Ps* means the same thing. Given this equivalence, if *every* exhibits an individual-denoting reading in nonsubject positions, then we might expect (7.104a) and (7.104b) to share the reading where Michael stands next to some musicians but not others, but in fact only (7.104b) has such a reading:

(7.104a) Michael stood next to every musician in his band.[20]

(7.104b) Michael stood next to the musicians in his band.

Second, and more important, this analysis falls apart given more oblique arguments. Recall that one of the reasons we could even consider the idea that *every* is individual-denoting in (7.96) is that it is the innermost quantified argument, and distributive elements can only betray their distributive nature by distributing over some dependent element, such as an existential quantifier within its scope. If we can show that *every* simultaneously distributes over such an existential and satisfies the sort of neutral reading exemplified in (7.96), then we can defeat the proposal that *every* is individual-denoting.

It's not necessary that this reading be the only available reading of the critical example; it is enough that this reading exist, since under the Davidsonian account there is no apparent analysis of it. For instance, in a situation where the *Boston Globe* and the *Boston Herald* are the only two employers of reporters in Boston, and the *Globe* sends each of its reporters to ten countries in Africa in the course of the year and the *Herald* does the same, we can truthfully utter (7.105):

(7.105) The two newspapers (together) dispatched every reporter in Boston to ten countries in Africa during the last year.

In (7.105), *every reporter* is neutral with respect to *two newspapers*, in the sense that two newspapers dispatch reporters and every reporter is dispatched, but no commitments are made about how the atomic events are distributed. However, *every reporter* is distributive with respect to *ten countries*, since for each reporter, there are ten (potentially different) countries to which that reporter is dispatched. Actually, we don't even need a lexically distributive determiner to demonstrate this reading; I believe that (7.106) can be interpreted in a parallel manner:

(7.106) The two newspapers (together) dispatched twenty reporters to ten countries in Africa.

In the Davidsonian interpretation of either of these cases, treating *every* or *twenty* as individual-denoting produces a reading in which no more than ten countries altogether are involved, while treating *every* or *twenty* as distributive produces the team reading of *two newspapers*:

(7.107) $$\begin{aligned}&\lambda e[\exists x(newspaper'(x) \wedge |x| = 2 \wedge \\ &\quad \exists z(country'(z) \wedge |z| = 10 \wedge \\ &\quad dispatch'(z)(\sigma w[reporter'(w)])(x)(e)))]\end{aligned}$$

(7.108) $\lambda e[\exists x(newspaper'(x) \wedge |x| = 2 \wedge$
$MinPred(\lambda e'[\forall y(reporter'(y) \rightarrow$
$\exists e''(e'' \leq e' \wedge \exists z(country'(z) \wedge |z| = 10 \wedge$
$dispatch'(z)(y)(x)(e''))))])(e))]$

So first, there seems to be no way to escape a distributive sense of *every*, since it is unambiguously distributive in subject position; and distributivity in general seems to be a problem no matter what, since when it occurs it is consistent with a neutral reading with respect to superior quantifiers. Based on these observations, then, I conclude that the facts of distributivity in semantic composition at least warrant serious consideration of this argument in favor of neo-Davidsonian semantic composition.

We will see, however, that the default Davidsonian account is not the only possible Davidsonian account. I will present two alternative solutions: a model-based solution, put forward by Lasersohn (1990; 1995), and my own composition-based solution. I will argue that these two accounts describe the data at least as well as the neo-Davidsonian account does.

7.3.3.2 Ruling out scope variation

Another plausible response to the contrast between the neutral and team readings is that this contrast is somehow due to scope variation. In this section, I will briefly demonstrate that given the range of operators in the standard Davidsonian account, this response fails to account for the data in any way.

Consider, for instance, the possible scope variation in (7.109):

(7.109) Michael and LaToya washed every car in the driveway.

There are two operators here which might induce scope contrasts: *every* and *and*. I will continue to assume that *every* is distributive throughout. On the other hand, *and* might have two readings: the individual sum reading, in which case it has no scopal force, or the conjunction of two type-raised individuals, which amounts to distributing over the individuals. We thus derive the following readings of (7.109):

(7.110a) individual sum *and*:

"For every car x in the driveway, the plural individual consisting of Michael and LaToya washed x."

(7.110b) type-raised conjunction with wide scope:
"For every car x in the driveway, Michael washed x and for every car x in the driveway, LaToya washed x."

(7.110c) type-raised conjunction with narrow scope:
"For every car x in the driveway, Michael washed x and LaToya washed x."

So given the operators we have to work with, what we get are the team reading and the two alternative distributive meanings; the neutral reading does not appear.

A similar result obtains when we consider cardinal modifiers:

(7.111) Two people washed every car in the driveway.

Again, we have two operators to play with: *every* and *two*. We will consider two possible analyses of *two*, the analysis in terms of plural individuals and an analysis in terms of quantification over atoms.

(7.112a) individual *two* with narrow scope:
"For every car x in the driveway, there is some group of people of size two which washed x."

(7.112b) individual *two* with wide scope:
"There is some group x of people of size two and for every car y in the driveway, x washed y."

(7.112c) distributive *two* with narrow scope:
"For every car x in the driveway, there are two people y and y washed x."

(7.112d) distributive *two* with wide scope:
"There are two people y and for every car x in the driveway, y washed x."

Clearly, we have fared no better here. In (7.112a) and (7.112b), we have different team readings; in (7.112b) it's the same team in all cases, in (7.112a) it may be different teams. The other two readings are the two distributive alternatives. Again, the neutral reading is nowhere to be found.

Furthermore, we can demonstrate fairly conclusively that nothing unusual has to be going on with scope to get the neutral reading with non-subject distributive generalized quantifiers, because the desired reading arises in cases where the object must be interpreted with narrow scope.

For instance, consider the interaction of these elements with durational adverbs:[21]

(7.113) Michael and LaToya washed every car in the driveway in less than an hour.

On the intended reading, the entire group of car washing events took place in less than an hour, and Michael and LaToya somehow divided up the effort between them. So the object distributive must occur within the scope of the durational VP modifier. Since this example can manifest the desired neutral reading, it can't be the case that the subject and object NPs stand in an unusual scope relationship in order to generate this reading.

In the same vein, Liu (1990) and Ben-Shalom (1993) report that very few nonsubject generalized quantifiers can bear wide scope under any circumstances, and downward-entailing generalized quantifiers in general cannot:

(7.114) Two boys washed fewer than three cars.
* = "For fewer than three cars x, two boys washed x"

So in those cases where downward-entailing nonsubject distributive generalized quantifiers induce neutral readings, the nonsubject quantifier cannot bear wide scope:

(7.115) The ten boys in Troop 165 earned fewer than fifteen merit badges in more than two years.

Based on this range of observations, I conclude that there is no hope of providing an account of these neutral readings in terms of scope variation. Armed with this conclusion, I turn to the two alternative solutions.

7.3.3.3 Alternative 1: team credit

Consider once again the Davidsonian analysis of (7.96):

(7.116) $\lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge MinPred(\lambda e''[\forall y(car'(y) \rightarrow \exists e'(e' \leq e'' \wedge wash'(y)(x)(e')))])(e))]$

I noted that this interpretation models the team reading, where every car is washed by the team of two people, and noted that in the situation where one person washed some of the cars and another person washed the rest, this interpretation was false. However, this assertion relies on a view of the model where $wash'(a)(b + c)$ is false if b washes a alone and c does not participate. The boldest reply to the problem with the Davidsonian account, then, is to attack this assumption directly. So let's investigate the possibility that $wash'(a)(b + c)$ is true in such a situation. This is Lasersohn's notion of *team credit*.

Team credit attempts to avoid the problem of expressing the neutral reading of examples like (7.96) by proposing that it is possible to attribute responsibility to actors which are not directly involved in the action. Lasersohn (1990) attempts to motivate team credit with the following story:

> I don't think this is as implausible as it may at first appear. It is actually common practice to attribute an action to a group even if only some of its members actually performed it. Imagine a competition in which teams are required to attempt various stunts, including lifting a piano. John and Mary form one team, Bill and Susan form another. During the competition, John lifts the piano; meanwhile Mary performs one of the other stunts, say shooting herself out of a cannon. When Bill and Sue's turn arrives, they succeed in doing almost all the stunts that John and Mary did, but fail at lifting the piano, and therefore lose the competition. In this sort of situation, it seems fair to say that *John and Mary won the competition because* THEY *lifted the piano* [emphasis mine - SB], while Bill and Sue didn't. This is despite the fact that Mary played no role in the actual lifting. (p. 188)

Lasersohn implements this notion most explicitly in Lasersohn (1995). Lasersohn's Davidsonian semantics differs in some notable respects from the version I developed in Chapter 4. The relevant differences are:

- In my Davidsonian account, the event argument is the final argument, while in Lasersohn's account it is the initial argument. So Lasersohn's lexical predicates essentially map events into sets of sequences of individuals.

- In my Davidsonian account, events are minimal, as I argued in Chapter 5. Lasersohn's events, as I observed there, are not. So a lexical predicate like $kiss'$ maps events into those sequences of individuals which stand in the kissing relation somewhere in that event.

- Lasersohn's syntax is a phrase structure syntax rather than a categorial syntax, and he admits a level of LF to deal with quantifier scoping.

- Lasersohn's account of plurals is a multi-level set account, which involves set formation rather than the join operator $+$.

Given the relative order of Lasersohn's Davidsonian argument, transitive verbs map events into sets of pairs of individuals (so their type is $\langle \epsilon, \langle e, \langle e, t \rangle \rangle \rangle$), and intransitive verbs and VPs map events into sets of individuals (so their type is $\langle \epsilon, \langle e, t \rangle \rangle$). Generalized quantifiers map these Davidsonian VPs into sets of events, and sentences, as usual, denote sets of events.

I will translate Lasersohn's interpretation rules into lambda notation, for convenience. He gives the following interpretation rules for transitive verbs and VPs:

(7.117a) $[\![[_{\mathrm{VP}}\ \mathrm{V\ NP}]]\!] = \lambda e \lambda x[[\![\mathrm{V}]\!](e)([\![\mathrm{NP}]\!])(x)]$
(7.117b) $[\![[_{\mathrm{S}}\ \mathrm{NP\ VP}]]\!] = \lambda e[[\![\mathrm{VP}]\!](e)([\![\mathrm{NP}]\!])]$

For Lasersohn, all generalized quantifiers are raised at Logical Form, adjoining either to S or to VP. These quantifiers are indexed with the NPs they leave behind in the usual way; for any raised NP with index i, the NP trace is interpreted as a variable with index i, and the interpretation of the raised constituent involves substituting values for the appropriate variable in an assignment function. For a given assignment function g,

(7.118a) $[\![[_{\mathrm{S}}\ \mathrm{NP}_i\ \mathrm{S}]]\!]^g = [\![\mathrm{NP}_i]\!](\lambda x[[\![\mathrm{S}]\!]^{g[x/i]}])$
(7.118b) $[\![[_{\mathrm{VP}}\ \mathrm{NP}_i\ \mathrm{VP}]]\!]^g = \lambda e \lambda x[[\![\mathrm{NP}_i]\!](\lambda y \lambda e'[[\![\mathrm{VP}]\!]^{g[y/i]}(e')(x)])(e)]$

At this point, we are prepared to discuss the implementation of team credit. How can it be true in the scenario outlined above that John and Mary lifted the piano, even though only John did the actual lifting? Lasersohn proposes that "team credit is more-or-less automatic whenever the combined effects of a group's actions are pragmatically relevant

...(p. 198)" But Lasersohn is not proposing that this phenomenon is simply a matter of pragmatic accommodation which has no reflex in the actual sentence denotation. Lasersohn suggests that the event in which John and Mary lift the piano has a subpart in which only John lifts the piano.[22] That is, the following statements about the model describe this situation:

(7.119a) $[\![\text{lift the piano}]\!](e) = \{\langle\{j, m\}, p\rangle, \langle j, p\rangle, \ldots\}$
(7.119b) $[\![\text{lift the piano}]\!](e') = \{\langle\{j, m\}, p\rangle, \langle j, p\rangle\}$
(7.119c) $[\![\text{lift the piano}]\!](e'') = \{\langle j, p\rangle\}$
(7.119d) $e'' < e' \leq e$

So if we assume that Mary does not lift the piano alone anywhere in e, then e and e' are in the denotation of *John and Mary lift the piano*, but not e''. The event e'' represents the actual lifting of the piano by John, and e' represents the (immediately?) larger event in which team credit is assigned.

This assignment of team credit immediately addresses the problem with (7.96). Assume a fairly large event e_{wash} in which every car in the driveway is washed. Assume further, as we did in (3.57), that there are ten cars and Michael washes six of them and LaToya four. Then Lasersohn's denotation of *wash* might minimally have the following properties:

(7.120) $[\![\text{wash}]\!](e_{wash}) =$
$\{\langle m, car_1\rangle, \ldots, \langle m, car_6\rangle, \langle l, car_7\rangle, \ldots, \langle l, car_{10}\rangle, \ldots\}$

For each washing, assume a minimal event:

(7.121a) $[\![\text{wash}]\!](e_1) = \{\langle m, car_1\rangle\}$
(7.121b) $[\![\text{wash}]\!](e_2) = \{\langle m, car_2\rangle\}$
etc.
(7.121c) $e_1, \ldots, e_{10} \leq e_{wash}$

Now assign team credit to each minimal event. I will illustrate with e_1:

(7.122a) $[\![\text{wash}]\!](e'_1) = \{\langle m, car_1\rangle, \langle\{m, l\}, car_1\rangle\}$
(7.122b) $e_1 < e'_1 < e_{wash}$

The denotation of *wash*, then, must minimally have the following properties:

(7.123) $[\![\text{wash}]\!](e_{wash}) = \{\langle m, car_1, \rangle, \langle \{m, l\}, car_1\rangle, \ldots,$
$\langle m, car_6\rangle, \langle \{m, l\}, car_6\rangle, \langle l, car_7\rangle, \langle \{m, l\}, car_7\rangle, \ldots,$
$\langle l, car_{10}\rangle, \langle \{m, l\}, car_{10}\rangle, \ldots\}$

Given a model like this, then, we can show that e_{wash} is in the denotation of (7.96), as follows:

(7.124a) $[\![\text{every}]\!] =$
$\lambda P \lambda f \lambda e[\forall x(P(x) \rightarrow f(x)(e))]$ (Lasersohn's definition)
(7.124b) $[\![\text{every car}]\!] =$
$\lambda f \lambda e[\forall x(car'(x) \rightarrow f(x)(e))]$
(7.124c) $[\![[_{\text{VP}}\ [_{\text{NP}}\ \text{every car}]_i\ [_{\text{VP}}\ \text{wash } \text{x}_i]]\!]^g =$ (by (7.118b))
$\lambda e \lambda x[[\![\text{every car}]\!](\lambda y \lambda e'[[\![\text{wash } \text{x}_i]\!]^{g[y/i]}(e')(x)])(e)]$
=(by (7.117a))
$\lambda e \lambda x[[\![\text{every car}]\!]$
$(\lambda y \lambda e'[\lambda e'' \lambda z[wash'(e'')(x_i)(z)]^{g[y/i]}(e')(x)])(e)] =$
$\lambda e \lambda x[[\![\text{every car}]\!](\lambda y \lambda e'[wash'(e')(y)(x)])(e)] =$
$\lambda e \lambda x[\lambda f \lambda e[\forall y(car'(y) \rightarrow$
$f(y)(e))](\lambda y \lambda e'[wash'(e')(y)(x)])(e)] =$
$\lambda e \lambda x[\forall y(car'(y) \rightarrow wash'(e)(y)(x))]$
(7.124d) $[\![\text{Michael and LaToya wash every car}]\!] =$ (by (7.117b))
$\lambda e[\lambda e \lambda x[\forall y(car'(y) \rightarrow wash'(e)(y)(x))](e)(\{m, l\})] =$
$\lambda e[\forall y(car'(y) \rightarrow wash'(e)(y)(\{m, l\}))]$

So Lasersohn's interpretation for (7.96) is equivalent to mine, modulo the differences in the structure of the model. Michael and LaToya wash every car in some event e iff for every car, $wash'(e)$ includes a pair consisting of that car and Michael and LaToya as the washers. But now, thanks to team credit, the denotation of *wash* in (7.123) satisfies this criterion for our event e_{wash}. If we can countenance the idea of team credit, then, nothing prevents a Davidsonian account from handling the supposedly recalcitrant neutral interpretations of nonsubject distributive generalized quantifiers.

7.3.3.4 Alternative 2: alter distributivity

Lasersohn's solution is model-based, in that it is supported by new assumptions which are made about the denotations of lexical predicates. The alternative I'd like to present now is composition-based, in that it proposes altering the rules by which distributive generalized quantifiers are incorporated into the semantics of sentences.

Think back to the discussion of (7.90) in the context of Lasersohn's discussion of passives and lexical distributivity. We observed that if *kill* is distributive on its object argument, then if a nonatomic individual is killed by an individual x, then its atomic parts are killed by subparts of that individual x. This description of distributivity is just as valid for the proper interpretation of (7.96); instead of requiring that for every car, the same team of two people wash it, as (7.116) does, we ought to require that for every car, some subpart of that team of two people wash it.

In other words, the interpretation of (7.96) ought to be

$$(7.125)\quad \lambda e[\exists x(people'(x) \wedge |x| = 2 \wedge MinPred(\lambda e''[\forall y(car'(y) \rightarrow \exists x' \exists e'(e' \leq e'' \wedge x' \leq x \wedge wash'(y)(x)(e')))])(e))]$$

This interpretation differs crucially from the previous one in that it associates each subevent with a subpart of the overall subject individual.[23] This difference is embodied in the clause $x' \leq x$. We might propose, then, that all distributive generalized quantifiers can be combined with their arguments via a type shifter which introduces this subpart relation. This shifter will incorporate the distributive generalized quantifier for the most oblique argument, and introduce the subpart relation for every dominating argument besides the outermost event argument. For a Davidsonian predicate R of valence n, this amounts to introducing $n-2$ subpart relations, as defined here in (7.126):

$$(7.126)\quad \lambda \mathcal{D} \lambda R_n \lambda x_1 \ldots x_{n-2}[\mathcal{D}(\lambda y \lambda e[\exists x'_1 \ldots x'_{n-2}(x'_1 \leq x \wedge \ldots \wedge x'_{n-2} \leq x_{n-2} \wedge R_n(y)(x'_1) \ldots (x'_{n-2})(e))])]$$

Because this type-shifter does nothing to the event argument, and merely binds the most oblique argument, its effects begin to manifest themselves for $n \geq 3$. So for some Davidsonian transitive verb, $n = 3$, (7.126) is instantiated as follows:

$$(7.127)\quad \lambda \mathcal{D} \lambda R_3 \lambda x[\mathcal{D}(\lambda y \lambda e[\exists x'(x' \leq x \wedge R_3(y)(x')(e))])]$$

Now recall the definition of *every* from (5.45), repeated here:

$$(5.45)\quad [\![\text{every}]\!] = \lambda P \lambda E[MinPred(\lambda e[\forall x(P(x) \rightarrow \exists e'(e' \leq e \wedge E(x)(e')))])]$$

For any CN denotation P, the interpretation of *every P* is the Davidsonian generalized quantifier

(7.128) $\lambda E[MinPred(\lambda e[\forall z(P(z) \rightarrow \exists e'(e' \leq e \wedge E(z)(e')))])]$

If we apply our type-shifter above to this NP meaning, we get the following function from transitive verbs to VPs:

(7.129) $\lambda\mathcal{D}\lambda R_3\lambda x[\mathcal{D}(\lambda y\lambda e[\exists x'(x' \leq x \wedge R_3(y)(x')(e))])](\lambda E[MinPred(\lambda e[\forall z(P(z) \rightarrow \exists e'(e' \leq e \wedge E(z)(e')))])]) =$
$\lambda R_3\lambda x[\lambda E[MinPred(\lambda e[\forall z(P(z) \rightarrow \exists e'(e' \leq e \wedge E(z)(e')))])](\lambda y\lambda e[\exists x'(x' \leq x \wedge R_3(y)(x')(e))])] =$
$\lambda R_3\lambda x[MinPred(\lambda e[\forall z(P(z) \rightarrow \exists e'(e' \leq e \wedge \lambda y\lambda e[\exists x'(x' \leq x \wedge R_3(y)(x')(e))](z)(e')))])] =$
$\lambda R_3\lambda x[MinPred(\lambda e[\forall z(P(z) \rightarrow \exists e'(e' \leq e \wedge \exists x'(x' \leq x \wedge R_3(z)(x')(e'))))])]$

So according to (7.129), (7.96) denotes that set of minimal events such that for every car, there is some subevent in which a subpart of Michael and LaToya washed it:

(7.130) $\lambda R_3\lambda x[MinPred(\lambda e[\forall z(car'(z) \rightarrow \exists e'(e' \leq e \wedge \exists x'(x' \leq x \wedge R_3(z)(x')(e'))))])](wash')(m+l) =$
$MinPred(\lambda e[\forall z(car'(z) \rightarrow \exists e'(e' \leq e \wedge \exists x'(x' \leq m+l \wedge wash'(z)(x')(e'))))])$

Because the proposed type shifter has the predicate R within the scope of the Davidsonian generalized quantifier, a distributive generalized quantifier like *every P* will distribute the elements of P over the predicate R according to the usual denotation of *every*. So more oblique arguments of R will bear the normal scopal relationship to *every*, since they will already have been incorporated into R. So *every* will be viewed as distributive with respect to more oblique arguments, and will "mimic" summativity with respect to less oblique arguments.

I illustrate with a derivation of a portion of (7.105), which features the ditransitive verb *dispatch*. First, we derive *dispatch to ten countries in Africa*:

(7.131) $[\![\text{dispatch to ten countries}]\!] =$
$\lambda y\lambda x\lambda e[\exists z(countries'(z) \wedge |z| = 10 \wedge dispatch'(z)(y)(x)(e))]$

This denotation is a Davidsonian transitive predicate, and so we can plug it in for R_3 in (7.129):[24]

(7.132) $[\![\text{dispatch every reporter to ten countries}]\!] =$
$$\lambda R_3 \lambda x[MinPred(\lambda e[\forall w(reporter'(w) \rightarrow \exists e'(e' \leq e \wedge \exists x'(x' \leq x \wedge R_3(w)(x')(e')))))])]$$
$$(\lambda y \lambda x \lambda e[\exists z(countries'(z) \wedge |z| = 10 \wedge dispatch'(z)(y)(x)(e))]) =$$
$$\lambda x[MinPred(\lambda e[\forall w(reporter'(w) \rightarrow \exists e'(e' \leq e \wedge \exists x'(x' \leq x \wedge \lambda y \lambda x \lambda e[\exists z(countries'(z) \wedge |z| = 10 \wedge dispatch'(z)(y)(x)(e))](w)(x')(e')))))])] =$$
$$\lambda x[MinPred(\lambda e[\forall w(reporter'(w) \rightarrow \exists e'(e' \leq e \wedge \exists x'(x' \leq x \wedge \exists z(countries'(z) \wedge |z| = 10 \wedge dispatch'(z)(w)(x')(e'))))))])]$$

So if the subject of this Davidsonian VP is *two newspapers*, the result of combining this subject and VP will be a minimal set of events such that for each reporter, there are ten countries to which that reporter is dispatched, and some subpart of the two newspapers does the dispatching. In other words, the resulting interpretation of *every* mimics scope-neutrality with respect to the dominating higher-scoped argument, and is distributive with respect to the dominated argument within its scope. So again, the Davidsonian account can be salvaged in the face of the neutral reading of (7.96).

7.4 Events and participation revisited

7.4.1 *Extra individuals*

I've now presented three different accounts of the neutral readings of nonsubject distributive generalized quantifiers. Schein's account (which I initially endorsed in Bayer (1996)) relies on the independence of neo-Davidsonian arguments; Lasersohn's alternative relies on assigning team credit in the Davidsonian arena; and mine introduces a new type-shifter which explicitly decomposes higher arguments.

These two Davidsonian alternatives spell trouble for the neo-Davidsonian choice. We have been searching for a reason to prefer the more radical neo-Davidsonian approach to semantic composition, and have so far failed to discover anything convincing. Given the defining properties of neo-Davidsonian composition, the argument based on nonsubject distributive generalized quantifiers appears to be the most likely to succeed, but it, too, admits Davidsonian alternatives.

In response, an advocate of the neo-Davidsonian alternative might argue that the two Davidsonian proposals outlined here are too "sloppy". For instance, let's return to our car-washings in (7.96), and examine the drawbacks of Lasersohn's proposal and of mine. Lasersohn validates the truth of (7.96) by assigning team credit to each of the individual washings. So the model which Lasersohn constructs also validates (7.133):

(7.133) Michael and LaToya washed car_1.

Is this true? It seems less and less likely as the overall group gets larger. So if LaToya's Toyota is parked in the Rose Bowl parking lot, then in order to validate (7.134), Lasersohn's model must also validate (7.135):

(7.134) The members of the UCLA football team washed every car in the Rose Bowl parking lot.

(7.135) The members of the UCLA football team washed LaToya's Toyota.

However, in this context, I find the truth of (7.135) dubious at best.[25] There are other contexts which render the assignment of team credit suspicious as well. Krifka (p.c.) observes that (7.136) seems to require that all the children actually participate:

(7.136) Of the seven children, three children/John, Bill and Mary built a raft.

My account has an analogous problem. Remember that I propose that each nonsubject element be acted on by a subpart of each relevant dominating element. Thus, if my interpretation strategy supports (7.96), it also supports (7.137), even if Jermaine washed no cars:

(7.137) Michael, LaToya and Jermaine washed every car in the driveway.

Again, as the number of nonparticipants gets larger, the likelihood of truth gets smaller. So my account also validates (7.138), even if the members of the UCLA football team washed no cars:

(7.138) Michael, LaToya and the members of the UCLA football team washed every car in the driveway.

Again, the truth of (7.138) seems dubious at best in this situation.

On the other hand, the neo-Davidsonian alternative seems not to "leak" in this way. Let's say it is true of some complex event e that Michael washes six cars in e, LaToya washes four, and Jermaine washes none. Then (7.96) is true of e in the neo-Davidsonian case and (7.137) is false. Why? If e is the sum of then atomic washings $e_1, \ldots, e_{10}$, and Michael and LaToya are the washers for all of these events, then the washer for e is the sum of Michael and LaToya, and Jermaine doesn't figure at all. In other words, summativity sums up participants, but doesn't support adding anyone "extra".

The problem is, there seem to be cases where this "leakage" is a good idea. Consider a downward-entailing nonsubject distributive generalized quantifier such as in (7.139):

(7.139) Michael and LaToya (together) washed fewer than three cars.

There is a very accessible reading of (7.139) in which Michael (or LaToya) need not be involved in any washings at all; the speaker simply intends to make it clear that their combined efforts (even if one of them failed to contribute at all) resulted in fewer than three cars being washed. Either my account or Lasersohn's can handle this case automatically, while the neo-Davidsonian account does not.

Now, if this argument actually ended up favoring the Davidsonian alternative (instead of merely failing to favor the neo-Davidsonian one), it would be worth constructing a detailed proof of the contrast. However, I believe that none of the three accounts tell the complete story. First of all, it's not that the neo-Davidsonian account fails in principle to account for these cases; it's that summativity of thematic roles is not the complete story. We might easily add something to the neo-Davidsonian account which would allow noncontributing participants under the appropriate circumstances. Such a revision is not incompatible with summativity, because summativity is not a biconditional; it licenses the presence of tuples consisting of larger elements, but does not require that those tuples be the only ones. Nor does the need for such a revision devalue the neo-Davidsonian account; after all, summativity is not the whole story for Lasersohn's or my account either. Lasersohn adds team credit; I add decomposition in quantification. From the point of view of formal complexity, then, we seem to have a draw.

With respect to the data, we seem to have a draw as well. The truth of (7.139) follows unproblematically in the given context under the Davidsonian accounts but not the neo-Davidsonian account, and this consequence is desirable; however, the truth of (7.135) and (7.138) follow unproblematically as well, and this consequence does *not* seem to be desirable. In addition, the Davidsonian accounts only present a partial account of noncontributing participants. My account, for instance, only applies to distributive determiners, but it's not clear that these are the only cases where noncontributing participants arise. Consider (7.140):

(7.140) Michael, LaToya and Jermaine washed a hundred cars.

In the situation where the driveway contains a hundred cars and Michael washed fifty, LaToya washed fifty, and Jermaine went to see a movie, (7.140) example seems no more or less true than (7.137), but if we treat cardinal numbers as existential quantification over plural individuals of the appropriate size, (7.140) will be subject not to the rule of distributivity in (7.126) but to the generalization of summativity. Since summativity does not license "extra" participants, (7.140) will be judged false in the given context, while (7.137) will be judged true. This result seems profoundly unsatisfying.

My account also has a problem with Passive. Since it is crucially dominating arguments which can be decomposed, my account predicts that the passive version of (7.139) is false if either Michael or LaToya did not participate:

(7.141) Fewer than three cars were washed by Michael and LaToya.

However, it is not clear that (7.141) has this property.

Lasersohn's account also makes odd predictions about passives. Because that account makes changes in the model directly, it must be the case that if (7.96) is true, then its passive must be true as well:

(7.142) Every car in the driveway was washed by Michael and LaToya.

However, my intuition is that (7.142) holds only if the team of Michael and LaToya actually washed every car; team credit is not enough. I argue, then, that no conclusions can be drawn from the facts of noncontributing participants which might currently choose among the three accounts presented here.

7.4.2 Distributivity and implicature

In some sense, the question of whether neutral readings of distributive nonsubject NPs motivate a neo-Davidsonian composition strategy is parallel to Carlson's discussion of *kick* or Parsons' discussion of dream contexts. In each of these cases, a particular subclass of phenomena (nonsubject quantification, requirements of participation) was selected with the intention of demonstrating that an order-based strategy could not handle all the cases of that phenomenon. Conversely, the neo-Davidsonian account of nonsubject quantification fares notably better than Carlson's *kick* proposal, since the latter seems to have critical flaws, once the details are fleshed out. Under these circumstances, which proposal to adopt is in many ways an issue of elegance and theoretical preference, based on whether subclass of the phenomenon in question is central or peripheral, frequent or rare. So one might attempt to argue that the neo-Davidsonian account is more elegant in these cases, but it is equally possible that the neutral reading is rare enough with nonsubject distributives that the elegance comes at far too high a cost.

There are two larger issues which bear upon the question of nonsubject neutral readings of distributives which I would like to visit briefly before I conclude. I have touched upon both these issues before, but they loom far larger in light of the current discussion. The first issue is the maximality of stated participants. In Section 7.2.3.3, I observed that the hearer is entitled to infer from (7.64), repeated here, that LaToya and Michael exhaustively comprise the songwriters:

(7.64) LaToya and Michael wrote a song.

I assumed above that this inference resulted from an entailment rather than an implicature, but I also stated that this assumption was a matter of convenience. A possible implicature-based account might rely on Grice's Maxim of Quantity or Horn's Q-based implicature (Horn, 1984) to explain that the source of the inference in (7.64) is the conversational rule that speakers are as informative as possible. Horn (1989) relies on this rule to provide an implicature-based account of the meanings of a wide range of scalars, such as numbers like *three*. For instance, if a speaker utters (7.143), the hearer is usually entitled to infer that John has no more than three children, at least as far as the speaker knows:

(7.143) John has three children.

Horn argues at length that this inference is a consequence of quantity-based implicature, rather than any particular property of the meaning of *three*. Because the Maxim of Quantity specifies that "more is better" (modulo other conflicting rules of conversation, as Horn makes clear), an asymmetry arises, where a maximality implicature is generated in upward-entailing contexts but something different happens in downward-entailing contexts:

(7.144) John has no more than three children.

So in (7.144), the implicature that manifests itself is that the speaker is not sure how many children John has, or that the fact that *three* is the upper bound on John's children is particularly important.

One might wish to argue that the maximality of stated participants is a consequence of quantity-based implicature as well. We've already seen that it is the upward-entailing cases which tend not to "leak" in terms of enumerating participants, and that it is more common in downward-entailing cases; furthermore, the leakage seems to be justified where there is some contextual motivation for it. So if I have three children, and I have some reason to deny the fact that one of them is a good-for-nothing bum, I might utter (7.145) even if the last child spent the summer hanging out on the beach:

(7.145) My children did lots of yard work this summer.

In terms of actual participation, (7.145) overstates the case, since one child contributed nothing; nevertheless, there is some contextual justification for the "leakage". From this point of view, both Lasersohn and I are on the right track, since the specification of extra participants is not ruled out in the semantics, as the neo-Davidsonian account implies. What both Lasersohn and I miss is the fact that it is pragmatic considerations which dictate which "leakages" are licensed. So Lasersohn might be wrong that there are model-theoretic repercussions of these "leakages", and I might be wrong that they are restricted to these nonsubject distributive contexts; indeed, we saw a counterexample to this generalization in (7.140). Finally, the gradual degradation of acceptability of extra participants as their numbers increase, as we saw a moment ago, is more compatible with a pragmatic explanation. If this is the case, then Lasersohn's account of team credit is essentially correct, and the particular phenomenon of nonsubject distributive readings does not support the neo-Davidsonian alternative at all.

The other issue which reinforces my conviction that the neo-Davidsonian advantage is illusory is the elusive quality of distributive determiners. I suggested in (7.101) above that we might interpret *every* as an individual-denoting determiner, and then dismissed the idea, based on its clear distributive preferences. However, the issue is not so clear. Landman (1993) makes the same proposal, based on the acceptability of *every*-NPs as the objects of clearly collective predicates:

(7.146) In this class, I will try to combine every semantic theory that has been proposed in the literature.

It has also been noted by Williams (1986) (and many others, I'm sure) that *everybody/everyone* is much more compatible with a group reading than *every N*:

(7.147a) Everybody/everyone met on the main green.
(7.147b) ?Every student met on the main green.

This "collective" behavior of distributive determiners is not as unusual as one might commonly think. One of the most striking examples is the ability of *most*-NPs*most* to antecede *each other*, as documented by Kim and Peters (1995):

(7.148) Most linguists loathe each other.

Kim and Peters (1995) draw their examples from naturally occurring data; in fact, Peters (p. c.) acknowledges that they encountered cases of *each*-NPs anteceding *each other*, and dismissed them from consideration based on their firm judgment that they were ungrammatical. If lexical distributivity of NPs is a sometimes thing, then perhaps the fact that these neutral readings occur with distributive nonsubject NPs shouldn't be at all surprising. The only remaining mystery is why these NPs are distributive with respect to lower arguments, as illustrated in (7.105), while they seem to be nondistributive with respect to lower arguments like *each other* here. I will leave this issue, as well as the issue of maximality of stated participants, for another time; my point here is that there is more than enough reason to doubt the stated properties of the very phenomena which are required to support the neo-Davidsonian alternative.

7.5 Conclusion

In this chapter, I have reviewed all the known ways in which neo-Davidsonian semantic composition might be found to differ from Davidsonian semantic composition. I have reviewed the major arguments put forward so far for neo-Davidsonian composition and shown that they do not support this radical alternative. I conclude, then, that there is no reason to adopt a neo-Davidsonian composition strategy.

However, there are some cases which I have yet to discuss which would undoubtedly benefit from such a strategy, and have yet to be satisfactorily covered in a Davidsonian framework. In the next chapter, I will attempt to address some of those problems.

Notes

[1]For details, see Krifka (1992).

[2] Unlike some theorists, Krifka does not assume that this relation holds for all thematic roles. He suggests that the *Stimulus* relation violates this principle, since with the same act of seeing one can see a zebra and the mane of that zebra.

[3]Krifka (p.c.) informs me that he explored this possibility at one point but rejected it for reasons of perspicuity.

[4]Here σ' is the past participial form of σ, about which I will have nothing to say. I will also ignore the details of the syntactic category of the result, which most likely does not directly take an NP argument. Cf. Bach (1980).

[5]Of the minority of verbs which do not, there are some subclasses of verbs which pattern like *kick* in lacking the relevant entailment, but those which elide the more "oblique", theme-like role verbs are few (Dowty cites *grasp, stab, strike, shoot*), and some of the others present problems for other aspects of the thematic role account. Other classes include causatives, in which the remaining role is either agentive or nonagentive:

(ia) The ice froze.
(ib) Jermaine froze the ice.

(iia) The dog walked.
(iib) LaToya walked the dog.

Dowty points out that these agentive causative examples lead to problems for some accounts of thematic roles. For instance, if we adopt broad thematic roles like *Agent*, there doesn't seem to be a way to distinguish semantically between *LaToya walked the dog* and *The dog walked LaToya*, since both participants are acting volitionally to some degree. Under an account of individual thematic roles such as the one I proposed in Chapter 6, no such problem arises, since the contrasts between individual thematic roles can be very fine-grained.

[6]Krifka (p.c.) describes another argument against neo-Davidsonian indexing which involves the reflexes in argument structure of lexical derivations. Verbal prefixes in German or Slavic can modify the aspectual properties of verbs and their arguments; so German *trinken* "to drink" contrasts with *austrinken* "to empty (a container of liquid) by

drinking it". If *aus-* indicates that the object must be completely subjected to the event, this generalization is difficult to express in a neo-Davidsonian account, since the verb has no semantic argument structure. Krifka's solution involved passing syntactic features, an undesirable strategy that he reports has been criticized convincingly in a master's thesis by Assinja Demjjanov.

[7]Thanks to Krifka (p.c.) for bringing this issue to my attention.

[8]One might even analyze it as a modifier; see Section 8.2.1.

[9]Admittedly, the generalization about *by*-phrases seems otherwise robust.

[10]Of course, *receipt* also has an (irrelevant) sense which describes the record of the transaction, but this is not a result nominalization in any plausible sense.

[11]There is a second reading of (7.61b) which is difficult to get in which the event described in the second clause is a different one than the first; this reading emerges when we add *also* or *too* to the second clause.

[12]One notable exception is Krifka (1992), who suggests that thematic roles like *Stimulus* do not meet this requirement. See Footnote 2 above.

[13]Unlike the case of participant requirements in our discussion of Carlson, this requirement does not choose between the order-based and role-based accounts.

[14]Dowty makes this same observation in connection with NP-internal coreference possibilities.

[15]I'm going to illustrate the relevant contrast with two direct arguments rather than any other type of constituents, to reduce confusion. However, any other type of constituents which bear the appropriate scopal relation to each other would induce the same contrast.

[16]This difference will presumably appear only when $e \neq e'$, of course.

[17]One way to salvage this account might be to resort to Lasersohn's notion of *team credit*, discussed in Section 7.3.3.3 below. Roughly, team credit assigns the participation in an event to a superset of the actual participants in just those situations where the context or semantics require it. Even if such an account could be made to work, it would be self-defeating for Lasersohn to adopt it here, because it would render his objection to (7.86) groundless.

[18]Recall that $MinPred(P)$ is the set of minimal elements of P; I use it here to enforce the collectivity of the proposed interpretation of *every*.

[19]Jacobson (p.c.) is not as sure of this intuition as I am.

[20]However, it seems that in some other contexts, particularly Passive *by*-phrases, there are some situations where this contrast is not so clear:

(i) Every screenwriter in Hollywood wrote *Gone With the Wind.*

(ii) *Gone With the Wind* was written by every screenwriter in Hollywood.

For me, at least, (i) is clearly bizarre, but (ii) has a possible reading where every screenwriter in Hollywood contributed to the writing of the movie.

If this judgment is correct, this contrast might derive from some exceptional interpretation of my proposal in Section 7.3.3.4 below. In that proposal, nonsubject distributive determiners are interpreted with respect to a *subpart* of their dominating arguments. The interpretation of "subpart" I intend in my discussion below is a conservative one in which the summing of objects does not "cross" ontological borders. So I ignore the possibility that if I sum together an axe handle and an axe blade, I get an individual which is an axe. However, if one admits the more liberal interpretation, (ii) might be susceptible to my analysis. I leave this issue for further research.

[21]Thanks to Krifka (p.c.) for bringing this class of examples to my attention.

[22]In a subsequent revision, Lasersohn abandons the distinction between the event in which team credit is assigned and the event which corresponds to what actually happened, in an attempt to address a flaw in his analysis of the meaning of *together.* I find this final revision problematic and counterintuitive. Since very little rides on the details of Lasersohn's account besides the actual notion of team credit, and because I find his initial account more plausible and easier to justify, I will adopt it here.

[23]Note that this interpretation does not require that every subpart of the subject participates; see Section 7.4.1 below.

[24]Syntactically, of course, matters are a little more complicated. This portion of the derivation involves the wrap operation, which I will not deal with in this thesis. Cf. Section 4.2.

[25]Krifka (p.c.) reports that the inference from (7.134) to (7.135) is unproblematic for him. However, assignment of team credit is not universally acceptable for him either, as we are about to see.

Chapter 8

Argument Accessibility and Events

Consider the problem of arguing that thematic roles are or are not necessary in a given grammatical system. Such a debate will always be inconclusive; if I show that thematic roles account for a particular phenomenon and many other accounts do not, I could very easily have failed to anticipate an alternative which does not exploit thematic roles. Alternatively, if I demonstrate that there is an alternative to a thematically-based account of a particular phenomenon, there may very well be another phenomenon whose analysis demands thematic roles. Furthermore, the particular type or inventory of thematic roles may bear crucially on the debate; we might show that broad thematic roles are unnecessary or not definable, or that a particular inventory of broad thematic roles is ill-conceived, but still find a crucial use of individual thematic roles.

This issue bears crucially on the course of this thesis. In the previous chapter, I argued that the facts of semantic composition have yet to provide evidence for the neo-Davidsonian compositional alternative. Furthermore, since I based my investigation on the differences *in principle* between the neo-Davidsonian and Davidsonian alternatives, I think it's unlikely that any such supporting evidence will be found. However, I have not demonstrated that reference to thematic roles is entirely absent, merely that they are not exploited as indexing devices in semantic composition. It is entirely plausible that thematic roles may be referred to elsewhere in the grammar: in the lexicon, for instance. So while I cannot show that thematic roles are not needed in general, I can address some plausible uses of thematic roles and demonstrate that more plausible order-based alternatives exist. In this chapter, I will turn my attention to modification and argument accessibility, considering various proposals for thematically-based analyses of the Passive *by*-phrase and of argument orientation in adverbs. I will argue that like the arguments for neo-Davidsonian composition, thematically-based approaches to these phenomena have more appropriate order-based alternatives.

8.1 Background

In my discussion of Parsons (1990) in Chapter 7, I pointed out that the contrast between Davidsonian and neo-Davidsonian representations is essentially a debate about indexing strategies for verbal and nominal dependents. The neo-Davidsonian account proposes that all dependents are indexed by explicit relations, while the Davidsonian account proposes that some dependents (the syntactic arguments) are indexed by order, and some dependents (the syntactic modifiers) by explicit relation. The Davidsonian account treats this contrast as fairly shallow; for the most part, it is isomorphic with the contrast between syntactic argument and syntactic adjunct. It follows immediately that there is a large subset of dependents about which the two accounts agree. In general, temporal, locative, directional, comitative and instrumental arguments are typically associated with events in both accounts by explicit relations, such as the meanings of prepositions. I repeat (7.17) and (7.18) to illustrate:

(7.17) Davidsonian:
$[\![\text{LaToya arrived at noon}]\!] =$
$\lambda e[arrive'(l)(e) \wedge at'(e)(noon')]$

(7.18) neo-Davidsonian:
$[\![\text{LaToya arrived at noon}]\!] =$
$\lambda e[arrive'(e) \wedge \theta_{SU,arrive'}(l)(e) \wedge at'(e)(noon')]$

So with reference to many syntactic modifiers, the Davidsonian and neo-Davidsonian accounts look very much the same. Furthermore, in those cases where the accounts differ, the shallowness of the Davidsonian division is underscored by the fact that it is compositionally indistinguishable from the lexical neo-Davidsonian account, as exemplified in (7.20), repeated here:

(7.20) $\Box\forall x\forall e[run'_{Davidsonian}(x)(e) \leftrightarrow run'_{neoDavidsonian}(e) \wedge \theta_{SU,run'}(x)(e)]$

That is, the possibility always exists in an order-based event account that the meanings of lexical predicates can be assigned internal structure, and that that internal structure might involve thematic roles.

Now, if we consider the notion of broad thematic roles, we observe trivially that what we might view as thematic roles arise in an event-based semantics in the case of modification. Whatever the meanings of locative prepositions like *in*, *on*, *at*, etc., are, they associate aspects of the event (the location) to the event itself via explicit relations in semantic composition. While the meanings of these prepositions are clearly distinct (so they don't all mean *Location*, for instance), they are also definable by and large without reference to the type of the event (*in the park* describes a two- or three-dimensional space in which an event occurs, no matter what type of event it is) and thus qualify in some sense as "broad" thematic roles, although more specific than those in Gruber's inventory.

However, I think this interpretation of modification severely stretches the concept of thematic roles. Relabeling the meanings of prepositions which head modifiers as "thematic roles" does not really advance the cause of thematic roles, since the basic account of these modifiers is widely agreed upon in all event-based semantic accounts. I think a much more interesting question is whether any of these modifiers can be shown to refer to thematic roles typically associated with core arguments. That is, can we find modifiers which must refer to roles like *Agent* or *Theme* (or their individual thematic role equivalents)? If we could discover such modifiers, we would be able to illustrate that even if we can't prove that thematic roles are part of semantic composition of arguments, they must be part of semantics in some way.

In the rest of this chapter, I will explore the phenomenon of *argument-oriented adverbials*, which some might argue are instances of such modifiers. I will focus on adverbials of location and mannerand on the Passive *by*-phrase in English. I will demonstrate that although these modifiers reference arguments in nonobvious ways, the generalizations required are not couched in terms of thematic roles.

8.2 Modifiers

In this section, I will review the status of modifiers in general, as well as the data which motivate the discussion to follow.

8.2.1 Modifiers, arguments, and accessibility

The distinction between modifier and argument in both syntax and semantics is rather fuzzy. Linguists seem to share an intuition that some cases are clear-cut. The following is my interpretation of the criteria implicitly used to draw these distinctions:

- If a constituent occupies an obligatory complement position, it is (almost always) a syntactic argument.
- If a constituent is construed with the "deep" subject or object position of a verb of "high transitivity" (cf. Hopper and Thompson (1980), Hopper and Thompson (1982)), it is (almost always) a semantic argument.
- If the determination of a constituent's relation to its head is largely independent of the meaning of the head, it is (frequently) a semantic modifier.[1]
- If a constituent is optional and iterable (that is, multiple instances of complements of the same general type, such as location or manner, can be associated with the same head), it is (almost always) a syntactic and semantic modifier.

These criteria can reinforce each other. So *LaToya* in *LaToya kissed Michael* is a syntactic and semantic argument; the locative PPs in *LaToya kissed Michael in the park under a tree* are syntactic and semantic modifiers.

However, these criteria can also conflict. While directional adverbials are typically optional, and their relation to their heads is not dependent on the meaning of the head, they do not iterate:

(8.1) *Jermaine walked to the garage toward the door.

Manner adverbials also cannot iterate as VP-final modifiers, although they can cooccur with a given verb in different positions (VP- or S-initially):[2]

(8.2a) *LaToya slapped Michael carelessly cruelly.
(8.2b) LaToya carelessly slapped Michael cruelly.
(8.2c) Carelessly, LaToya slapped Michael cruelly.

In spite of these cooccurrence gaps, these adverbials are commonly treated as syntactic and semantic modifiers.

Sometimes these criteria can conflict in a way which imposes different designations in different dimensions. When manner or directional adverbials are required by certain predicates, they may be viewed as syntactic arguments (because they are obligatory) and semantic modifiers (because their relation to their head is still largely independent of the head). So *carefully* is an argument in (8.3a), a modifier in (8.3c); and *toward the stage door* is an argument in (8.3e), a modifier in (8.3g):

(8.3a) Jermaine worded the lyrics carefully.
(8.3b) *Jermaine worded the lyrics.
(8.3c) Jermaine wrote the lyrics carefully.
(8.3d) Jermaine wrote the lyrics.
(8.3e) Janet sidled toward the stage door.
(8.3f) *Janet sidled.
(8.3g) Janet slid toward the stage door.
(8.3h) Janet slid.

In spite of this proposed contrast, these adverbials retain their semantic force; *toward the stage door* indicates the direction of motion, whether the verb is *sidle* or *slide*.

These elements, however, pose no problem for an order-based account. We've already seen that thematic indexing can be encapsulated in lexical neo-Davidsonian predicates; the strategy for these syntactic arguments is very much the same. The verbs *slide* and *sidle* differ in their semantic valence, but the additional argument to *sidle* is internally represented as a predicate on events, just as modifiers typically are.[3] I will express the meaning of *sidle* in terms of an intransitive predicate $sidle''$, which relates a sidler and a sidling event:

(8.4a) $[\![\text{slide}]\!] = \lambda x \lambda e[slide'(x)(e)]$
(8.4b) $[\![\text{sidle}]\!] = \lambda P \lambda x \lambda e[sidle''(x)(e) \wedge P(e)]$

The elements which cause problems are those which are syntactic modifiers but either fill or refer to semantic argument positions.[4] If these modifiers combine with the verbal element at the VP level, then all arguments will be saturated but one at that point in the derivation. If the argument position which the syntactic modifier fills (or refers to) has already been saturated (that is, if it's anything besides the surface subject), then some mechanism must be invoked to allow the modifier to access that argument. The most obvious solution is to "name" the argument positions, and the most obvious way to name argument positions is to use thematic roles. In the remainder of this section, I will describe the data which bear on this potential use of thematic roles.

8.2.2 Adverbials 1: manner and direction

When I speak of syntactic modifiers referring to semantic arguments, I refer to the well-known tendency of some verbal modifiers to entail something about one or another of the arguments of the verb. I will call these modifiers *argument-oriented adverbials*. In some situations, these modifiers refer to arguments which do not correspond to the surface subject. If these modifiers are VP modifiers, we need to say something about how it is that these modifiers are able to predicate something of such nonsubject arguments.

There are two classes of argument-oriented adverbials, which differ in their interactions with the operation of Passive. The first class is discussed extensively by Keenan (1980). This class most frequently involves locative and directional modifiers. Keenan notes that that with certain verbs, these modifiers robustly introduce entailments about a specific argument:

(8.5a) LaToya brought Jermaine from the studio.
(8.5b) LaToya signaled Jermaine from the studio.

In (8.5a), LaToya may or may not be in the studio, but Jermaine must be. In (8.5b), on the other hand, it is LaToya and not Jermaine who must be in the studio. Furthermore, the argument orientation of these entailments is unchanged by the application of Passive:

(8.6a) Jermaine was brought from the studio.
(8.6b) Jermaine was signaled from the studio.

Even though not all the arguments are explicit, the source locative modifying Passive *bring* robustly locates the item brought, while the source locative modifying Passive *signal* robustly locates the signaler. Notice, crucially, that the orientation of the entailment is a property of the verb, not of the modifier itself. I will call these cases *orientation-governed adverbials*.

The second class of adverbials is the class of so-called *passive-sensitive* adverbials. The prototypical instances of these adverbials seem to be manner adverbials; Landman gives the example of *reluctantly*. Landman, following Jackendoff (1972), Thomason and Stalnaker (1973), McConnell-Ginet (1982) and others, points out that the only possibilities for construal with *reluctantly* are the active subject position or the deep subject or object in passives:

(8.7a) Reluctantly, Caesar sold Crassus the slave. (Caesar is reluctant)
(8.7b) Reluctantly, the slave was sold by Caesar to Crassus. (either the slave or Caesar is reluctant)
(8.7c) Reluctantly, Crassus was sold the slave by Caesar. (either Crassus or Caesar is reluctant)

We can compare these possibilities to the possibilities for source locatives above:

(8.8a) LaToya reluctantly brought Jermaine from the studio. (LaToya is reluctant)
(8.8b) LaToya reluctantly signaled Jermaine from the studio. (LaToya is reluctant)
(8.8c) Jermaine was reluctantly brought from the studio by LaToya. (either LaToya or Jermaine is reluctant)
(8.8d) Jermaine was reluctantly signaled from the studio by LaToya. (either LaToya or Jermaine is reluctant)[5]

So this class of adverbials differs from the first in that its orientation possibilities are independent of the particular verb, but dependent on the voice of the verb.[6]

Of the construal possibilities for these adverbials, the problematic ones are construal with the deep subject in Passive. If these adverbials are VP modifiers, predicating something of the surface subject is never a problem, since in a Davidsonian account these modifiers denote functions from Davidsonian VP denotations to Davidsonian VP denotations, which bear an open argument position corresponding to the surface subject. In the case of construal with the Passive deep subject, on the other hand, there is arguably no open argument position to assign some predication to. Below, I will explore the various solutions to this potential problem.

8.2.3 Adverbials 2: the Passive by*-phrase*

In addition to providing a diagnostic for construal of adverbs, the operation of Passive introduces an element which in its own right provides a problem for modifier construal: the Passive *by*-phrase, which appears syntactically to be a modifier rather than an argument. While this contrast is sometimes rather murky, I agree with Grimshaw (1990), Keenan (1980) and Landman (1993) that the evidence favors the modifier account. I will provide two arguments for this position. In the discussion to follow, I will argue for the modifier status of the English *by*-phrase in particular, although at various points I will use "*by*-phrase" to stand in for any oblique phrase in any language which introduces the logical subject in a Passive construction.

Our first hint is that by the criteria outlined above, the *by*-phrase is a semantic argument (since it's construed with the deep argument of verbs of high transitivity and its relation to the head is dependent on the meaning of the head) and might be a syntactic modifier, because even though it is not iterable, it is robustly optional across languages, as pointed out by Keenan and Faltz (1979),[7] Keenan (1980) and Grimshaw (1990). This degree of optionality parallels no other type of argument in the English verbal paradigm; the optionality of verbal arguments such as the object of *eat* is stated on a case-by-case basis, rather than across the entire grammar. As an argument, then, the *by*-phrase is typologically unusual. As a modifier, on the other hand, it is utterly unexceptional; modifiers are automatically optional, since they are not subcategorized for. Thus, if the *by*-phrase were a syntactic modifier, nothing more would need to be said about its "exceptional" optionality. Furthermore, as Keenan points out, there are a number of languages in which Passive does not tolerate any *by*-phrase at all (that is, Passive in such languages is obligatorily "agentless"), while there are no known languages in which Passive *requires* a *by*-phrase. Crosslinguistically, then, the expression of the logical subject in Passive constructions mirrors the behavior of modifiers.

While this argument seems fairly strong, we must admit some typological inconsistencies in regarding the *by*-phrase crosslinguistically as a modifier. For instance, we saw in (8.3) above that elements which are syntactic modifiers can become syntactic arguments because they're (arbitrarily) required by certain lexical items. Thus, we ought to expect that the *by*-phrase might also be obligatory with certain items. As yet, however, I know of no such cases. Grimshaw (1990) discusses two possible cases of obligatory *by*-phrases, but she points out that neither is clearcut. The first case involves what initially appear to be obligatory *by*-phrases with the verbs *build* and *design*:

(8.9a) *This house was built/designed.
(8.9b) This house was built/designed by a French architect.

However, Grimshaw note that these verbs actually require *some* adjunct, not necessarily a *by*-phrase:

(8.10a) This house was built/designed in ten days.
(8.10b) This house was built in a bad part of town.
(8.10c) This house was designed without community input.

While the alternation between the *by*-phrase and more conventional syntactic modifiers might be taken as supporting the modifier status of the *by*-phrase, it does not illustrate the "exceptional" obligatoriness we seek, since verbs like *word* do not allow alternations between manner adverbials and other modifiers:

(8.11) *LaToya worded the letter at the kitchen table.

Grimshaw's second case involves adjectival passives like *rimmed* and *capped*:

(8.12a) This mountain is capped *(by snow).
(8.12b) That volcano is rimmed *(by craters).

However, Grimshaw points out that the fact that these are not verbal passives may render them irrelevant to the current discussion, and that like the complement of *build*, the *by*-phrase alternates here as well, in this case with modifiers introduced by *with*:

(8.13) This mountain is capped with snow.

So while the *by*-phrase patterns with modifiers in many ways, we have yet to find a convincing case of an "exceptionally" obligatory *by*-phrase. Nevertheless, it seems that the rest of the pattern is fairly robust.

My second argument for the modifier status of the *by*-phrase is my own; at least, I do not know of this observation being made elsewhere. It depends on the properties of VP ellipsis. If we embrace a constituent structure in which all arguments of the verb are within VP, and modifiers are adjoined to VP, we expect that VP ellipsis may strand modifiers but may never strand arguments:

(8.14a) LaToya gave a book to Jermaine on Tuesday, but Michael didn't.
(8.14b) LaToya gave a book to Jermaine on Tuesday, and Michael did on Wednesday.
(8.14c) *LaToya gave a book to Jermaine, and Michael did an album to Janet.
(8.14d) *LaToya gave a book to Jermaine, and Michael did to Janet.

By this metric, the *by*-phrase is a modifier, because it can be stranded outside VP ellipsis:

(8.15) LaToya was never insulted by Jermaine, but Michael was by Janet.[8]

We can demonstrate that this phenomenon is VP ellipsis and not Gapping because we cannot strand the second object of ditransitives:

(8.16) LaToya was never given a book by Jermaine, but Michael was (*a record) by Janet.

Now, there are some modifiers which do not seem to strand, as in (8.17):

(8.17) *LaToya ran into the house, and Michael did out of the yard.

But this observation does not affect the conclusion here; to invalidate the argument, we would need to find a constituent which is commonly regarded as an argument which VP ellipsis can strand. No such constituent seems to exist; S and VP complements cannot be stranded any more easily than NP and PP complements:[9]

(8.18a) *LaToya learned that the Beatles broke up, and Michael did that the Stones were still performing.
(8.18b) *LaToya persuaded Michael to undergo plastic surgery, and Jermaine did to dye his hair.

So we have two arguments which suggest that the *by*-phrase is syntactically a modifier. But again, if the *by*-phrase is a VP modifier, we have an immediate problem, because the argument position the complement of *by* fills is no longer available for construal. In the sections to follow, I will explore the various ways of accomplishing this construal.

8.3 Against thematic roles for argument construal

As I suggested above, if we wish to reference arguments other than the surface subject, the most available account of "naming" arguments for the purposes of construal involves thematic roles. In this section, I will explore the possibility of relying on thematic roles as an explanation for construal with such arguments. In both of the cases we've described, I will reject this possibility.

8.3.1 Adverbials 1: manner and direction

The two types of adverbials we've discussed present different problems for argument referral. In each case, it is the way construal survives Passive which creates the problem. In the case of orientation-governed adverbials such as *from the studio* in (8.5a) and (8.5b), which argument is referenced is dependent on what the verb is. We can show further that the construal is not a grammatical phenomenon because of the properties of nominalizations; locations of signaling events, for instance, seem to locate the signaler no matter what:

(8.19) The signaling of Batman from the roof of City Hall surprised the residents of Gotham City.

So we might handle the construal of source locatives with the "deep" subject of *signal* via the following meaning postulate:

(8.20) $\Box[\forall e \forall x \forall y((signal'(e) \wedge from'(y)(e) \wedge Agent(x,e)) \rightarrow from'(y)(x))]$

That is, this construal is a fact about signaling, rather than a grammatical property of construal or semantic composition. Furthermore, one could probably tell a very plausible story about why these meaning postulates dictate the construal that they do. For instance, what might it mean to locate a signaling event? It may be far more informative to locate the signaler rather than the individual signaled, since we don't necessarily know where the individual signaled is. Similarly, in the events of bringing in (8.5) and (8.6), since the individual brought is the individual which moves, it may be more informative to locate the individual brought.

However, as long as we have events, and as long as we are representing these facts as facts about the world and not about grammar, nothing stops us from referring to the Davidsonian predicate corresponding to the denotation of the active verb in our meaning postulate. In other words, we don't need thematic roles at all:[10]

(8.21) $\Box[\forall e \forall x \forall y \forall z((signal'(y)(x)(e) \wedge from'(z)(e)) \rightarrow from'(z)(x))]$

So in spite of their initial relevance, the facts of orientation-governed adverbials do not support reference to thematic roles.

The case of passive-sensitive adverbials presents a somewhat different problem, because the construal of these adverbials is independent of which verb is modified. In this case, if we were to rely on a thematic role account, the role which was referenced by a given adverbial would have to remain constant for all verbs. This role reference is only needed in those cases where the role referred corresponds to the deep subject and not the surface subject, i.e., the deep subject in Passive. Otherwise, these adverbials can refer straightforwardly to the surface subject, which is an open argument position.[11] So if we rely on thematic roles in the "exceptional" case, an account of *reluctantly* might look like this:

(8.22a) $[\![\text{reluctantly}]\!] = \lambda E \lambda x \lambda e[E(x)(e) \wedge reluctant'(x)(e)]$
(8.22b) $[\![\text{reluctantly}]\!] = \lambda E \lambda x \lambda e[E(x)(e) \wedge \exists y(\theta_{SU}(y)(e) \wedge reluctant'(y)(e))]$

So *reluctantly*, like all passive-sensitive adverbials, is essentially ambiguous, in one sense asserting that the surface subject is reluctant in a given event and in the other sense asserting that the filler of the thematic role θ_{SU} is reluctant in that event. However, there are a number of problems in identifying θ_{SU}. The first, and perhaps most severe, is that it is the logical subject which is referenced, independent of what role is assigned to the logical subject. So *reluctantly* has the same range of reference possibilities when it modifies *receive*, even thought the logical subject of *receive* is a *Goal* or *Recipient* and the subject of *sell* in (8.7) above is an *Agent*:

(8.23a) Reluctantly, Jermaine received the gift.
(8.23b) Reluctantly, the gift was received by Jermaine.

In the active sentence here, Jermaine is reluctant. This fact is unproblematic, since the sense of *reluctantly* which applies here is the one which references argument order, not thematic roles. However, in the Passive case, Jermaine is still reluctant.[12] But if we conclude on this basis that $\theta_{SU} = \mathit{Recipient}$, we have no explanation for construal with *Caesar* in (8.7b), repeated here, since *Caesar*, the filler of θ_{SU}, is presumably an *Agent* or *Source*:

(8.7b) Reluctantly, the slave was sold by Caesar to Crassus. (either the slave or Caesar is reluctant)

And if we assume that there are multiple senses of *reluctantly*, one referring to *Recipient*, one referring to *Source*, we derive the equally troubling and false result that *reluctantly* in its *Recipient* sense ought to be construed with *Crassus* in (8.7a), repeated here:

(8.7a) Reluctantly, Caesar sold Crassus the slave. (Caesar is reluctant)

As the number of thematic roles multiply, the problem gets worse. And if broad thematic roles cannot be justified semantically, as argued by Dowty (1991), turning to individual thematic roles in this situation would be utterly disastrous. We'd face the same problem faced by Krifka's determiners: since the thematic role is part of the meaning of the manner adverb, we would have to postulate a different meaning for each adverb for every passivizable verb. The generalization which is being missed here is that the "second" sense of *reluctantly* refers to the logical subject, not to a thematic role.

We can reinforce this point by examining verbs whose thematic role properties are degenerate in some way. For example, consider pairs which seem to impose different "views" on the same event: *buy/sell*, *borrow/lend*, *borrow/lend*, *rent/rent*.[13] For instance, while both buyers and sellers engage in conscious, volitional, purposeful action in the process of conducting a transaction, construal is unambiguously determined by argument structure rather than thematic structure. So compare (8.7) with (8.24):

(8.7a) Reluctantly, Caesar sold Crassus the slave. (Caesar is reluctant)
(8.7b) Reluctantly, the slave was sold by Caesar to Crassus. (either the slave or Caesar is reluctant)
(8.7c) Reluctantly, Crassus was sold the slave by Caesar. (either Crassus or Caesar is reluctant)

(8.24a) Reluctantly, Crassus bought the slave from Caesar. (Crassus is reluctant)
(8.24b) Reluctantly, the slave was bought by Crassus from Caesar. (either the slave or Crassus is reluctant)

In these cases, the manner adverb is construed with the logical or surface subject, even though both the buyer and the seller and intentionally and volitionally involved.

This point can be reinforced further by examining another class of verbs which does not support traditional thematic role generalizations: the *out-* class.[14] These verbs relate two individuals involved in the same state/activity, with one exceeding the other in some way. In many cases, the exceeded individual is not actually required to have participated; however, there is a subclass of these verbs where both individuals are required to participate simply due to real-world constraints:

(8.25) LaToya outlived Michael/*the rock.

These verbs include *outlast*, *outlive*, *outnumber*, *outweigh*, and perhaps *outshine*. Since the subject and object are participating in the same state/activity (just differentially so), if manner adverbials exhibit a preference with these verbs, it can't possibly have anything to do with traditional thematic roles. And in fact, the manner adverbs we are concerned with do exhibit a preference:

(8.26a) LaToya resourcefully outlived Michael.
(8.26b) Michael was resourcefully outlived.

Both LaToya and Michael can display resourcefulness in attempting to survive, but only the "winner" is asserted to be resourceful in (8.26).

The larger class of *out-* predicates also supports this point. These include *outbid*, *outdistance*, *outdo*, *outfox*, *outmaneuver*, *outperform*, *outplay*, *outride*, *outrun*, *outsell*, *outshoot*, *outspend*, *outsmart*, *outstrip*, *outwit*, *outthink*, and *outwork*. So in (8.27), LaToya and Michael are both bidding, but LaToya "wins":[15]

(8.27) LaToya outbid Michael for the antique jukebox.

As indicated above, these differ from the *out-* verbs discussed above in that for some speakers, they actually do not entail that their object does anything at all. So for some speakers, (8.28) is not contradictory:

(8.28) LaToya outbid Michael for the antique jukebox, because Michael didn't submit a bid.

Modulo this contrast, the manner adverbs we are concerned with behave in the expected way:

(8.29a) LaToya vigorously outbid Michael.
(8.29b) Michael was vigorously outbid.

Both LaToya and Michael can bid vigorously, but only the winner is asserted to be vigorous in (8.29).[16] Now, it's entirely possible in this case that we simply have the wrong inventory of broad thematic roles, and that there *is* some role (call it *Winner*) which distinguishes between the arguments of *out-* verbs. However, this hypothesis would simply add another role to the list of competitors for the identity of θ_{SU}, and simply compound the problem I described in reference to *receive*.

Before I dismiss a thematic role account of passive-sensitive adverbials entirely, I ought to mention that Landman (1993) also examines and rejects a thematic account of this construal. He refers to both McConnell-Ginet (1982) and Wyner (1994), who assume that argument orientation is thematically driven, and that the function of Passive is to "add" (semantic) features to the subject which attract the orientation of the adverb.[17] So under these accounts, Passive sentences must mean something different than their corresponding actives; however, Landman points out that except for scopal contrasts which are explicable without reference to thematic roles, no such meaning difference has ever been demonstrated, nor has any proposal of this type explained why this supposed meaning difference would result in a contrast in adverbial orientation. To these objections, I would add that since construal with the deep subject is also possible in Passive cases, sometimes Passive adds these semantic features and sometimes it doesn't, which is utterly mysterious. For all these reasons, I reject a thematic account of adverbial construal for passive-sensitive adverbials.

8.3.2 Adverbials 2: the Passive by*-phrase*

With this discussion in mind, we turn once again to Passive itself. As we saw above, in addition to providing a diagnostic for argument construal, Passive optionally licenses an element which is arguably a syntactic modifier but clearly a semantic argument, namely, the *by*-phrase. In order to see whether thematic roles are appropriate for dealing with the construal of the *by*-phrase, I will examine the account of Passive found in Landman (1993). Landman's account is a type of lexical neo-Davidsonian account, which I will describe briefly before I discuss his account of Passive.

Landman, like Lasersohn and me, has a special type for events, which I will continue to notate as ϵ. However, his type system distinguishes crucially between functions from individuals to truth values ($\langle e, t\rangle$ and $\langle \epsilon, t\rangle$) and sets of individuals (which he notates as $pow(e)$ and $pow(\epsilon)$ respectively).[19] Landman introduces a range of basic semantic constants of various types (notated CON_{type}), out of which lexical denotations are constructed. These constants include thematic roles, which for Landman are functions from events to individuals:

(8.30a) $\mathrm{CON}_{pow(e)} = \{BOY, BLOCK, \ldots\}$
(8.30b) $\mathrm{CON}_{pow(\epsilon)} = \{KISS, WALK, \ldots\}$
(8.30c) $\mathrm{CON}_{\langle \epsilon, e\rangle} = \{Ag, Th, \ldots\}$

The maximal elements of $\mathrm{CON}_{pow(e)}$ and $\mathrm{CON}_{pow(\epsilon)}$ are both named DOM.

Elements of type $pow(e)$ and $pow(\epsilon)$ can also be constructed by set formation. Set formation is *restricted* by a given set of individuals. So the set of red blocks is the set of all individuals x in the set $BLOCK$ which are red:

(8.31) $\{x \in BLOCK : red(x)\}$

Landman constructs Davidsonian verbal meanings out of these building blocks. The transitive verb *kiss*, for instance, is a function from pairs of individuals into sets of events, that is, of type $\langle e, \langle e, pow(\epsilon)\rangle\rangle$:

(8.32) $[\![\text{kiss}]\!] = \lambda y \lambda x[\{e \in KISS : Ag(e) = x \wedge Th(e) = y\}]$

With these tools, we can now turn to Landman's account of Passive. As I pointed out above, Landman agrees that *by*-phrases are modifiers. He provides an account of Passive which is designed to support this position. Landman's passive operator looks like this:

(8.33) $PASS(\lambda y \lambda x[\{e \in R : \phi\}]) = \lambda y[\{e \in R : \exists x \in DOM : \phi\}]$

That is, given a transitive verb which is a function into sets of elements e drawn from a set R in $\mathrm{CON}_{pow(\epsilon)}$ for which some proposition ϕ is true, the corresponding Passive existentially quantifies over the variable corresponding to the logical subject argument position, drawing elements from DOM.[20] Thus, the denotation of *be kissed* looks like this:

(8.34) $[\![\text{be kissed}]\!] =$
$PASS(\lambda y \lambda x[\{e \in KISS : Ag(e) = x \wedge Th(e) = y\}]) =$
$\lambda y[\{e \in KISS : \exists x \in DOM : Ag(e) = x \wedge Th(e) = y\}]$

So *Mary was kissed,* before existential closure over the event, is the set of event individuals in the $KISS$ set whose *Theme* is Mary and which have some *Agent*. Now, what about the *by*-phrase? Landman proposes, quite simply, that the *by*-phrase is a modifier which adds the Agent:

(8.35) $[\![\text{by}]\!] = \lambda x \lambda V \lambda y[\{e \in DOM : e \in V(y) \wedge Ag(e) = x\}]$

So *be kissed by John* ends up with the meaning in (8.36):

(8.36) $\lambda y[\{e \in DOM : e \in \{e \in KISS : \exists x \in DOM :$
$Ag(e) = x \wedge Th(e) = y\} \wedge Ag(e) = j\}]$

We can eliminate the level of set structure which restricts e to DOM:

(8.37) $\lambda y[\{e \in KISS : \exists x \in DOM : Ag(e) = x \wedge Th(e) = y \wedge$
$Ag(e) = j\}]$

What renders (8.37) equivalent to the interpretation of the corresponding active sentence is the assumption that thematic role fillers are unique, as discussed with respect to (7.63). So for each e in (8.36), there can only be one Agent, and since it is asserted both that there is an Agent and that John fills the Agent role, John must be the sole agent. Given this line of reasoning, (8.37) is equivalent to

(8.38) $\lambda y[\{e \in KISS : Th(e) = y \wedge Ag(e) = j\}]$

There are a number of problems with this account, some of which parallel the problems with thematically-governed construal of manner adverbials. First, it isn't compositional. The Passive operator in (8.33) must have access to the internal "structure" of the active verbal denotation in order to produce the corresponding passive denotation. While this is not an automatically fatal flaw, a compositional account should be preferred. Second, the *by*-phrase in Passive isn't limited to adding *Agent* participants; it adds whatever role the logical subject fills. Not only does this mean that *by* itself must be multiply ambiguous, to fill in the various roles which logical subjects of transitive verbs can assume, it is a mystery why it just so happens that the meaning for *by* that we need is the one that happens to correspond to the role for the logical subject of the predicate in question. That is, even though *by* clearly needs to be able to add a *Recipient* (as in *The package was received by the child*), this *Recipient by* never turns up as the modifier of *be kissed*. And as with manner adverbs, if we're forced to retreat to individual thematic roles because broad thematic roles can't be justified, we'd need a different sense of *by* for every passivizable verb. I conclude that while the *by*-phrase seems to be a modifier, attempting to assign a thematic role to the *by*-phrase looks like the wrong strategy.

8.4 The order-based alternative

If thematic roles won't work as a strategy for accessing the deep subject argument in Passive, then how do we access it? I have been assuming so far that the modifiers in question are VP modifiers; presumably, one way of accessing the deep subject position is to reject that assumption and assume that these modifiers are TVP modifiers, which yield a TVP which then undergoes Passive. In this section, I will review a range of such accounts and demonstrate why they don't work.

8.4.1 Background: Dowty's account of Passive

The properties of Passive are crucial both to using it as a diagnostic and to analyzing the properties of the *by*-phrase. Accordingly, I will begin by reviewing one of the most well-known model-theoretic accounts of Passive, that of Dowty (1982). Dowty's account is similar to that of Bach (1980), to which I will return later.

Dowty's goal is to demonstrate that clause-based accounts of grammatical relations such as those found in Relational Grammar and Transformational Grammar fail to capture a range of insights available to a predicate-based Montagovian account which defines grammatical relations derivatively, in terms of obliqueness of arguments. For Dowty, the subject is the final argument to combine with the verbal element; the direct object is the second-to-last element; etc. Similarly, grammatical relation-changing rules become operations on obliqueness order, which reassign grammatical relations as a side effect.

For Dowty, Passive is actually two rules, an Agentless Passive rule and an Agentive Passive rule. The first is a relation-reducing rule:

(8.39) Agentless Passive
S6: $\langle F_6, \langle TV \rangle, IV \rangle$
Semantic Operation: $\lambda y[\exists x(\alpha'(y)(x))]$
English: $F_6(\alpha) = be^\frown \alpha'$, where α' is the passive form of α.

That is, *be loved* is the set of all individuals such that someone loves that individual. The agentive passive, on the other hand, is an unusual sort of rule of argument combination, which combines a two-place predicate with a term argument by construing the term argument as the least oblique argument rather than the most oblique:

(8.40) Agentive Passive
S7: $\langle F_7, \langle TV, T \rangle, IV \rangle$
Semantic Operation: $\lambda y[\alpha'(y)(\beta')]$
English: $F_7(\alpha, \beta) = be^\frown \alpha'^\frown by^\frown \beta'$, where α' is the passive form of α and β' is the accusative form of β.

In other words, given a transitive verb *love* and a term argument β, the agentive passive produces an IV containing the passive form of *love* with β in the *by*-phrase, and this IV denotes the set of individuals which are loved by β.

There are two obvious problems with Dowty's account. The first is that there are two different rules of Passive, which makes it appear that a generalization is being missed. Perhaps, then, we might "uncollapse" Dowty's rule of Agentive Passive into a relation-rearranging rule which transforms an active verb into a verb which denotes the inverse relation and subcategorizes for a *by*-phrase. We might then eliminate the rule of Agentless Passive by subjecting the new two-argument predicate to an independently-motivated rule of Detransitivization which eliminates the innermost argument of a two-argument predicate and existentially quantifies over the corresponding semantic argument position (cf. (7.23)). This reanalysis would thus require only one rule which is unique to the Passive construction.

The first problem with this reanalysis is that Detransitivization is quite restricted lexically, but the crosslinguistic optionality of the *by*-

phrase in Passive is quite robust. The second problem is that this reanalysis makes Agentive Passive the basic form, while the fact that there are no languages which require the *by*-phrase make this implication quite suspicious. The third problem with this reanalysis, and the second problem with Dowty's original account, is that it does not respect the evidence that the *by*-phrase is a modifier.

So can we develop an account of Passive in which Agentless Passive is primary, and the *by*-phrase is a modifier? We might begin by attempting to construct a variant of Dowty's account which has these properties. But what would the *by*-phrase modify? If we intended the *by*-phrase to modify a constituent such as the output of Dowty's Agentless Passive rule, we would find that the *by*-phrase had no way to provide a semantic argument to the eventuality being described, since the argument position it needed to fill would already be "closed" by existential quantification. This problem is parallel to the problem of existential closure of event arguments, and as we did in the case of existential event closure, it seems that what we must do here is leave the argument position open.[21]

So let's try another variation on Dowty's approach. What if the rule of Agentive Passive (or the application of passive morphology) simply reversed the relation in question? Then we might analyze the *by*-phrase as a function from relations to sets of individuals, saturating the appropriate argument in the process:

(8.41) $[\![\text{by}]\!] = \lambda x \lambda R \lambda y[R(x)(y)]$

In this way, we could interpret the *by*-phrase as a syntactic adjunct, but still fill the argument position of the relation. In other words, the *by*-phrase would be a valence-reducing adjunct, which is a somewhat odd beast, but by no means unmanageable.

Nevertheless, this account is even more problem-ridden than the last. First, this proposal is really no more than a type-raised version of the original revision of Dowty's account I proposed above. Indeed, this solution does no more to address the array of rules required: we either still have two rules of Passive, or we can try to derive the Agentless Passive from the Agentive Passive, which, as we've seen, is typologically suspect in that it both makes agentive Passive primary and requires a suspiciously robust operation of Detransitivization. Second, we haven't even addressed the issue of the *syntactic* type of the output of this altered rule of Agentive Passive. It can't be a function from *by*-phrases to IVs, because that would make the *by*-phrase an argument; but if it's a TV, nothing stops it from taking an internal argument as the logical subject, and if it's a VP, we've abandoned the correspondence between syntactic and semantic types, which really isn't an option in the classical account. Third, it's no longer clear what *requires* the output of Agentive Passive to be modified by a *by*-phrase; but such a requirement clearly needs to be imposed, since the most oblique argument of the output of Agentive Passive *must* be saturated somehow before the last argument is absorbed.

The robust optionality of the *by*-phrase and the primacy of Agentless Passive suggests that the rule of Passive is essentially Dowty's rule of Agentless Passive in (8.39). And this conclusion leaves us right back where we started: we don't know how to construe the *by*-phrase with the deep subject argument.

8.4.2 Passive as a phrase-level operator

The problems with adequately revising Dowty's account of Passive simply illustrate that with respect to construal of the *by*-phrase, Passive is not the problem; adverbial modification is. So let's look at a potential solution.

According to Dowty, Passive is a rule which maps a TV into an IV. Nothing requires that the TV be a word; it might be a complex TV, perhaps incorporating a modifier. With this preview in mind, consider the account of passive-sensitive adverbials of Landman (1993). Following Jackendoff (1972), Thomason and Stalnaker (1973), McConnell-Ginet (1982) and others, Landman suggests that the construal of *reluctantly* with either the active subject or the "deep" subject or object in passives suggests an account in which *reluctantly* encodes subject construal for both VPs and TVPs, and where modification can either precede or follow Passive:

(8.42a) TV: $[\![\text{reluctantly}]\!] =$
$$\lambda V \lambda y \lambda x[\{e \in DOM : e \in V(y)(x) \wedge RELUCTANT(x,e)\}]$$
(8.42b) VP: $[\![\text{reluctantly}]\!] =$
$$\lambda V \lambda x[\{e \in DOM : e \in V(x) \wedge RELUCTANT(x,e)\}]$$

Assume first that Passive does not apply. Then construal will be with the deep and surface subject, no matter whether modification happens at the TV or the VP level. Next, assume that *reluctantly* modifies the output of Passive. Then the VP-type interpretation for *reluctantly* will induce construal with the surface Passive subject. Finally, assume that Passive applies to the output of modification at the TV level. Then the TV-type interpretation for *reluctantly* will induce construal with the deep subject, regardless of whether there is a surface *by*-phrase. Thus, by assuming that Passive can apply to either modified or unmodified TVs, hypothesizing that the modifier is always construed with the subject yields the appropriate range of possibilities.

A somewhat less successful version of this proposal is made by Keenan (1980). Like Dowty, Keenan explicitly adopts the hypothesis that Passive is a phrase-level operation. So in the case of *reluctantly*, Passive applies to the modified verb, and if construal is determined at the point of modification, the construal will survive Passive.

Unlike Landman, Keenan attempts to apply his analysis to the case of orientation-governed adverbials, and has significantly less success. The first problem with the analysis Keenan presents is that it requires him to analyze the locative in (8.6b) as a TVP modifier, since Passive must apply to the modified TVP to allow construal with the deep subject. Now, we know that directionals must also be VP modifiers, since they can modify intransitives:

(8.43) LaToya arrived from the garden.

But nothing in Keenan's account *requires* that the locative modification precede Passive in the case of TVPs. So if construal is based on argument order at the point of modification, we ought to be able to find cases where it is the subject of the Passive VP *be signaled* which must be located by the locative modifier, while the location of the "deep" subject is left unspecified, but we don't. In other words, Keenan's account misses the crucial fact that the orientation of the adverb is governed by the head. Of course, we've already seen in Section 8.3.1 above that the invariance of adverbial construal in the orientation-governed case, together with the fact that the orientation is determined by the class of event, means that an account which is independent of surface argument structure can be presented.

The sort of account Keenan proposes is much better suited to adverbials where the orientation does not vary, such as the Passive *by*-phrase, and in fact, Keenan does attempt to apply this proposal to the Passive *by*-phrase. But because Keenan has no more luck accessing a "closed" argument position than Dowty does, he requires that the *by*-phrase modify a TVP so that the "deep" subject position will be open. Furthermore, since Passive is a valence-reducing operation for Keenan (as it is for Dowty), the modification of the *by*-phrase must precede Passive. The question that immediately arises, of course, is what blocks (8.44):

(8.44) *LaToya kissed Jermaine by Michael.

That is, what forces the application of Passive once the *by*-phrase has modified the TVP? Keenan suggests that it is the semantics of the *by*-phrase which dictates the ungrammaticality of (8.44):

(8.45) $\forall R \forall x \forall y \forall z (by'(x)(R)(y)(z) = R(y)(x))$

Keenan says that this definition forces the application of Passive because without it, we are specifying the semantic subject of R with two differently-referring NPs. As far as I can tell, this conclusion is simply wrong. Keenan's meaning for *by* causes the surface subject of (8.44) to be ignored, rather than placed in conflict with the object of *by*. Furthermore, Keenan's filter doesn't rule out cases where the surface subject and the object of *by* are coreferential:

(8.46) *LaToya kissed Jermaine by LaToya.

Thus, Keenan's phrase-level rule of Passive is adequate for neither the *by*-phrase or orientation-governed adverbials.

8.4.3 *Passive as a word-level operation*

So far, we've had mixed luck relying on Passive as a phrase-level operation to give us access to the deep subject position for the purposes of adverbial construal. Of the various types of adverbials we've discussed, only the passive-sensitive adverbials seem susceptible to such an analysis. In this section, I will dismiss even this possibility, by demonstrating that Passive must be a word-level operation.

First, one might level a mild methodological objection against a phrase-level account because it violates the principle that morphological operations apply to words in the lexicon. A morphological operation must apply to the head verb in the course of the application of Passive, but this operation occurs in the syntax, not in the lexicon, and must "look inside" the constituent to do so. It's not clear how much force this objection has, considering the need to passivize lexical verb + particle combinations like *pick up*; but I think there's a much more powerful argument to be leveled against a phrase-level account, based on the facts of quantifier scoping.

Consider an Agentless Passive account such as Dowty's, which maps TVPs into VPs. These TVPs can be complex; in Dowty's case, they may consist of ditransitive predicates which have already absorbed their most oblique argument. So the TVP *introduce to LaToya* undergoes Agentless Passive, yielding *be introduced to LaToya*:[22]

(8.47)

Jermaine, NP, j — introduce, TV/PP, $introduce'$ — to LaToya, PP, l

FA: introduce to LaToya, TV,
$introduce'(l)$

(8.39): be introduced to LaToya, IV,
$\lambda y[\exists x(introduce'(l)(y)(x))]$

FA: Jermaine is introduced to LaToya, S,
$\exists x(introduce'(l)(j)(x))$

Now, what happens if the most oblique argument is quantificational? Consider the denotation of *introduce to every musician*, derived by some operation equivalent to Argument Raising (cf. Chapter 4):

(8.48) $[\![\text{introduce to every musician}]\!] =$
$\lambda y \lambda x[\forall z(musician'(z) \rightarrow introduce'(z)(y)(x))]$

If we apply the Agentless Passive rule in (8.39) to this denotation, we get (8.49):

(8.49) $[\![\text{be introduced to every musician}]\!] =$
$\lambda y[\exists x(\forall z(musician'(z) \rightarrow introduce'(z)(y)(x)))]$

That is, on the simplest derivation, the phrase-level passive account requires that in (8.50), Jermaine is introduced by the same individual to every musician:

(8.50) Jermaine was introduced to every musician.

This reading is too strong, though. The sentence in (8.50) is compatible with Jermaine being introduced to each musician by a different individual. That is, the existential quantifier introduced by Passive always has innermost scope. To model the weaker interpretation of (8.50), the rule of Agentless Passive would need an alternative formulation which operates on predicates whose innermost argument expects a generalized quantifier, and whatever rule supports the absorption of the ditransitive complement would have to set up a complex argument-raised structure as output:

(8.51) Agentless Passive
S6: $\langle F_6, \langle IV/T \rangle, IV \rangle$
Semantic Operation: $\lambda y[\alpha'(y)(\lambda P[\exists x(P(x))])]$
English: $F_6(\alpha) = be^\frown \alpha'$, where α' is the passive form of α.

(8.52) $[\![$introduce to every musician$]\!]$ =
$\lambda y \lambda \mathcal{D}[\forall z(musician'(z) \rightarrow \mathcal{D}(\lambda x[introduce'(z)(y)(x)]))]$

In this way, we would be able to set up a situation where the ditransitive complement outscopes the existential quantifier over the logical subject introduced by the Passive rule:

(8.53) $[\![$be introduced to every musician$]\!]$ =

$$\begin{aligned}
&\lambda y[\lambda y \lambda \mathcal{D}[\forall z(musician'(z) \rightarrow \\
&\quad \mathcal{D}(\lambda x[introduce'(z)(y)(x)]))](y)(\lambda P[\exists w(P(w))])] = \\
&\lambda y[\lambda \mathcal{D}[\forall z(musician'(z) \rightarrow \\
&\quad \mathcal{D}(\lambda x[introduce'(z)(y)(x)]))](\lambda P[\exists w(P(w))])] = \\
&\lambda y[\forall z(musician'(z) \rightarrow \\
&\quad \lambda P[\exists w(P(w))](\lambda x[introduce'(z)(y)(x)]))] = \\
&\lambda y[\forall z(musician'(z) \rightarrow \\
&\quad \exists w(\lambda x[introduce'(z)(y)(x)](w)))] = \\
&\lambda y[\forall z(musician'(z) \rightarrow \exists w(introduce'(z)(y)(w)))]
\end{aligned}$$

So far, the mechanics required are complex and stipulative, but the account seems to be observationally adequate. Crucially, however, in order to make this account work, the ditransitive complement generalized quantifier must outscope the subject position. But there is a body of independent research that argues that this scope configuration is limited almost exclusively to universal quantifiers (cf. Ben-Shalom (1993) and references therein). So *no* in non-subject position never takes wide scope:

(8.54) One of the composers introduced Jermaine to no musicians.
(*= "for no musician x did one of the composers introduce Jermaine to x")

Yet in the corresponding Passive, the ditransitive complement *no musicians* outscopes the Passive existential quantifier introduced in subject position:

(8.55) Jermaine was introduced to no musicians.
(= "For no musician x did anyone introduce Jermaine to x")

One might object that the generalization about quantifier scoping I'm appealing to is irrelevant here, because the violation in question is not a configuration of surface NPs. However, as long as quantifier scope is determined by the order of argument lifting operations on verbs, whether or not the argument filler corresponds to a surface NP is not relevant. And if Passive is a phrase-level operation in an ordered-argument account, it seems impossible to generate the appropriate interpretation of (8.55) without also generating the inappropriate (8.54), because what enables both interpretations simultaneously is the active argument-lifted interpretation in (8.52). If Passive is a word-level rule, on the other hand, the existential quantifier will always have narrowest scope, which conforms to the observations made here. Therefore, I conclude that the facts of scope strongly favor a word-level account of Passive.

If Passive is a word-level rule, then it cannot apply to modified TVPs to enable adverbial construal with deep subjects. However, so far I've only shown that complex TVPs incorporating more oblique arguments cannot undergo Passive; I have not yet discussed constituents which consist of a TVP + modifier. I think it's easy to show that this complex constituent is not eligible to undergo Passive either. The argument is parallel to the scope argument above:

(8.56) That song was performed at no Boston arena.
(*= "For some individual x, there is no Boston arena at which x performed that song")

The existential quantifier in (8.56) introduced by Passive cannot outscope the GQ *no Boston arena* in the locative modifier, yet if Passive could follow modification, this scoping ought to be possible. It's somewhat harder to demonstrate the same scope properties for manner adverbs, which do not lend themselves well to quantified NP paraphrases, but (8.57) might be such an example:

(8.57) That song was performed with no regrets.
(*= "For some individual x, there are no regrets with which x performed that song")

More likely, however, manner adverbials of this form are stylistic in nature and don't really show anything about the facts of quantifier scope:[23]

(8.58) LaToya departed with a reluctance which belied her good mood.

Nevertheless, it would be exceptionally odd for Passive to apply to some TVP + modifier constituents and not others.

Keenan believes that Passive is a phrase-level rather than a word-level rule, but his critique of the latter is fairly weak. He argues primarily for the notion that morphological operations apply to entire phrases, not just words, by way of defending the realization of Passive morphology on the head verb of a Passive construction created in the syntax rather than the lexicon. However, while Keenan presents a number of possible examples of this sort of morphological operation, he provides no reason to prefer such analyses to the more conservative word-level accounts.

More seriously, Bach (1980) offers three plausible criticisms of the word-level account; I will discuss two of them here. First, he argues that the range of TVPs which govern Passive represents an enormous array of possible oblique arguments. The verb *persuade*, for instance, selects for an infinitival VP; the verb *consider* selects for a predicative NP or AP complement. The rule of Passive would need to map these ternary predicates into the appropriate binary predicate, which would require quantifying over the syntactic categories and semantic types of the innermost argument. Bach describes these extensions as an unnecessary complication of Passive at best, and an unwanted extension of the power of lexical rules at worst. While Bach's concern is justifiable, I don't think it's well-founded. First, there are operations which generalize over syntactic categories; generalized conjunction leaps to mind. Second, it is not necessary to refer to the semantic types of any arguments other than the subject and object when defining the Passive operation; we can define the operation on sets of tuples of length ≥ 2 (≥ 3 in the Davidsonian case) which simply eliminates the element corresponding to the logical subject.

Bach's second point is that missing-object purpose clauses modify both some active transitives and their corresponding passives, but not other intransitives:

(8.59a) Mary bought the truck to deliver groceries with.
(8.59b) The truck was bought to deliver groceries with.
(8.59c) *The truck arrived to deliver groceries with.

(8.60a) John brought Dr. Schwartz in for us to talk to.
(8.60b) Dr. Schwartz was brought in for us to talk to.
(8.60c) *Dr. Schwartz entered for us to talk to.

If these modifiers combine with the TVP before the application of Passive, these modifiers do not need to select multiple category types; otherwise, they do. However, I think there is an alternative analysis here as well. If these purpose clauses are subcategorized for by the verb, instead of being modifiers, the operation which extends the valence of these verbs could apply in the lexicon, along with Passive. This view of missing-object purpose clauses as arguments parallels the account of *too/enough* and *tough* missing-object complements found in Hukari and Levine (1991).

I conclude, then, that the objections to a word-level view of Passive don't have much force. And if we can maintain our conclusion that Passive is a word-level rule, we lose even Landman's success with passive-sensitive adverbials. In the next section, I will present my order-based alternative to the phrase-level account which provides a solution both for passive-sensitive adverbials and the Passive *by*-phrase.

8.5 Global argument mapping

One of the surprising aspects of Landman's account of Passive is that while the Passive operation closes off the logical subject argument via existential quantification, the *by*-phrase still manages to fix the identity of this argument via subsequent modification. Landman exploits the assumption of thematic role uniqueness to ensure that the thematic role filler provided by the *by*-phrase is the same as the thematic role filler corresponding to the logical subject. That is, Landman has found a way to refer to argument positions which have already been filled. If we can reconstruct this account without reference to thematic roles, we may be able to eliminate some of the problems of Landman's account while preserving the insight that the *by*-phrase is a modifier.

We saw in the case of orientation-governed adverbials that we could use the canonical argument order of the denotations of active verbs to make generalizations about construal on a verb-by-verb basis. For the latter two adverbial classes, we must make a generalization across verbs. So consider the possibility of a global function from events to "canonical" argument orders, corresponding to the basic active voice. Given such an functions, generalizations about manner adverbs and the Passive *by*-phrase could be made in terms of these canonical orders, and these modifiers could robustly associate themselves with the appropriate argument positions (i) without requiring those argument positions to be open, (ii) without missing generalizations about these modifier types, and (iii) without referring to thematic roles.

8.5.1 *My proposal*

To make this proposal concrete, I will assume a function G which maps events into their (unique) canonical active participant sequences. The idea that such a function can be defined essentially implements the condition on uniqueness of participant sequences formulated in (7.62) above. Specifically, if the denotation of *buy* is as in (8.61), G must provide the mappings in (8.62):

(8.61) $[\![\text{buy}]\!] = \{\langle e_1, l, guitar_1\rangle, \langle e_2, j, guitar_2\rangle, \ldots\}$

(8.62) $G(e_1) = \langle l, guitar_1\rangle$
$G(e_2) = \langle j, guitar_2\rangle$
$\ldots$

If π_1 picks out the first element of any participant sequence, then we can define a passive-sensitive adverb like *reluctantly* as a Davidsonian VP modifier which is ambiguous between a sense which refers to the surface subject and a sense which refers to this canonical deep subject:

(8.63a) $[\![\text{reluctantly}]\!] = \lambda E \lambda x \lambda e[E(x)(e) \wedge reluctant'(x)(e)]$
(8.63b) $[\![\text{reluctantly}]\!] = \lambda E \lambda x \lambda e[E(x)(e) \wedge reluctant'(\pi_1(G(e)))(e)]$

This appeal to the initial element of canonical participant sequences might initially appear *ad hoc*, but let's consider what it attempts to model.

We've seen that verbs whose arguments do not contrast with each other in traditional thematic role terms nevertheless strongly favor construal of some manner adverbs with the logical subject, even when the Passive subject is just as likely to exhibit the manner specified and even when the logical subject is not present on the surface. Both the *out-* verbs and verbs of the *buy/sell* class have illustrated this point. We've also seen that attempting a thematically-based account of construal with deep arguments simply underscores the fact that it is the it is not the deep semantic level of thematic roles but rather the level of deep initial syntactic arguments which determines the "exceptional" construal possibilities in Passive. The canonical argument order accessed by the G function is exactly that initial argument order, and the index π_1 into that sequence is exactly the deep subject.

We can also provide an account of the Passive *by*-phrase. The first important fact is that with respect to verbs, the *by*-phrase is restricted to occurring with Passive. The rule of Passive must introduce a new syntactic category, which I will treat as non-complex. In proposing this separate category, I follow Bach (1980).[24] I thus modify the Passive rule from (7.24) as follows:

(8.64) Passive:
$$\langle \sigma, (\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{NP}, R_{\langle e,\langle e,\langle \epsilon,t\rangle\rangle\rangle}\rangle \Rightarrow$$
$$\langle \sigma', \mathrm{PASSV}, \lambda x\lambda e[\exists y(R(x)(y)(e))]\rangle$$

One of the categories which *be* subcategorizes for must be PASSV. As for the semantics, *by* simply references the deep subject. The lexical entry for *by* should be obvious at this point:

(8.65) $\langle$"by", $(\mathrm{PASSV}/_{\mathrm{L}}\mathrm{PASSV})/_{\mathrm{R}}\mathrm{NP}$,
$$\lambda x\lambda E\lambda y\lambda e[E(y)(e) \wedge x = \pi_1(G(e))]\rangle$$

The relevant definition of the copula is

(8.66) $\langle$"be", $(\mathrm{V}/_{\mathrm{L}}\mathrm{NP})/_{\mathrm{R}}\mathrm{PASSV}, \lambda E\lambda x\lambda e[E(x)(e)]\rangle$[25]

With these tools, I can provide a derivation of *Jermaine is kissed by Michael*:

(8.67)

$$\dfrac{\dfrac{\text{kissed}}{\text{PASSV}, \; \lambda x \lambda e[\exists y(kiss'(x)(y)(e))]} \quad \dfrac{\dfrac{\text{by}}{(\text{PASSV}/_{\text{L}}\text{PASSV})/_{\text{R}}\text{NP}, \; \lambda x \lambda E \lambda y \lambda e[E(y)(e) \wedge x = \pi_1(G(e))]} \quad \dfrac{\text{Michael}}{\text{NP}, \; m}}{\textbf{FA: } \text{PASSV}/_{\text{L}}\text{PASSV}, \; \lambda E \lambda y \lambda e[E(y)(e) \wedge m = \pi_1(G(e))]}}{\textbf{FA: } \text{PASSV}, \; \lambda x \lambda e[\exists y(kiss'(x)(y)(e)) \wedge m = \pi_1(G(e))]}$$

(8.68)

$$\dfrac{\dfrac{\text{Jermaine}}{\text{NP}, \; j} \quad \dfrac{\dfrac{\text{be}}{(\text{V}/_{\text{L}}\text{NP})/_{\text{R}}\text{PASSV}, \; \lambda E \lambda x \lambda e[E(x)(e)]} \quad \dfrac{\text{kissed by Michael}}{\text{PASSV}, \; \lambda x \lambda e[\exists y(kiss'(x)(y)(e)) \wedge m = \pi_1(G(e))]}}{\textbf{FA: } \text{V}/_{\text{L}}\text{NP}, \; \textbf{FA: } \lambda x \lambda e[\exists y(kiss'(x)(y)(e)) \wedge m = \pi_1(G(e))]}}{\textbf{FA: } \text{V}, \; \lambda e[\exists y(kiss'(j)(y)(e)) \wedge m = \pi_1(G(e))]}$$

So *Jermaine be kissed by Michael* is that set of events which are a kissing of Jermaine by somebody such that Michael is the first element of the canonical participant sequence associated with that event. This will only be true of those events which are a kissing of Jermaine by Michael. So if we assume unique participants, as Landman does, but replace thematic roles with deep order-based semantic arguments, we can account for the full range of modifiers we've been examining.

8.5.2 Do events determine unique participants?

Of course, this argument depends crucially on the idea that G is a function. The status of G as a function, correspondingly, depends crucially on the granularity of our Davidsonian elements. For instance, as we saw in Chapter 2, the view of Davidsonian elements found in Kratzer (1989) takes them to be situations, parts of worlds. Situations are potentially less fine-grained than events, and in particular, the sets of situations denoted by (2.41a) and (2.41b), repeated here, are identical:

(2.41a) LaToya bought the guitar from Michael.
(2.41b) Michael sold the guitar to LaToya.

But if every buying is a selling and vice versa, then G cannot be a function, since *buy* and *sell* have different argument structures.

I have taken pains not to restrict the type of Davidsonian elements unduly; the question at this point is whether there is any evidence which contradicts the assumption that buying and selling can be distinguished. An excellent summary of the range of granularity proposed in the literature on events is found in Parsons (1990). The coarse-grained view which Parsons describes is far coarser than Kratzer's; this view is commonly associated with Davidson:

(8.69a) Suppose I signal by raising my hand. Then my signaling is identical with my hand raising.
(8.69b) Suppose I come home, flip a light switch connected to a floodlight, and thereby alert a burglar. Then the flipping of the switch is identical with the alerting of the burglar.

The fine-grained view is commonly associated with Kim (1970), and is far finer than anything we might require:

(8.70a) Suppose that I illegally kill someone, and thereby murder her. Then my murdering her is different from my killing her.
(8.70b) Suppose that I sing loudly. Then my singing is distinct from my singing loudly.

Which of this wide range of positions is the correct one? In some sense, this question is meaningless without a purpose for the choice. Our goal is to investigate the properties of compositionality, so we will adopt this as our metric. Parsons holds the same view, and both he and Landman (1993) rely for their choice on what linguistic distinctions and entailments must be supported for the verbal predicates in question. This exercise relies mostly on patterns of inference involving modifiers, and conveniently corroborates the linguistic modification relationships I've already been discussing.

For instance, is every murder a killing? Parsons argues that linguistically, it is. Such an entailment justifies the following range of inferences:

(8.71a) If x murders y with a knife, then x kills y with a knife.
(8.71b) If x murders y in the hallway, then x kills y in the hallway.
(8.71c) If x murders y violently, then x kills y violently.

...

Certainly, these entailments could also be justified by requiring that for every murder event, there is a corresponding killing event with exactly the same properties; however, such an account would simply be perverse. In the same vein, *contra* Kim, if I sing loudly at midnight, then I sing at midnight, and the fact that the same range of modifiers describes my singing and my singing loudly supports their identity. Therefore, the pattern of inference implied by modification possibilities argues against Kim's fine-grained account for Davidsonian elements.

Similarly, we can show that the coarse-grained account is linguistically incorrect. As we saw in our discussion of event identity in Chapter 2, and as Parsons' argument against Kim implies, identical events ought to support the same range of modifiers. Parsons, following Taylor (1985), points out that if I signal to you by walking uphill, or sideways, or onto the grass, or in a zig-zag pattern, I do not thereby signal to you uphill, or sideways, or onto the grass, or in a zig-zag pattern. Thus if we take seriously the interchangeability of modifiers, then we must reject the coarse-grained account as well.

What does this say about *buy* vs. *sell*? We have already seen that these predicates do not support the same adverbial construals, and we've concluded that we can account for this if they represent distinct sets of events. We can confirm this hypothesis in the mode of Parsons and Landman by observing that these two verbs do not support the same set of modifiers either. For instance, *with*-PPs denoting the means of purchase are possible with *buy* but not *sell*:

(8.72a) LaToya bought the guitar from Michael with a hundred dollar bill.
(8.72b) *Michael sold the guitar to LaToya with a hundred dollar bill.

In a similar vein, Landman argues that *Source* can occur with buying but not with selling, and *Goal* can occur with selling but not with buying:

(8.73a) LaToya bought/*sold the guitar from Michael.
(8.73b) Michael sold/*bought the guitar to LaToya.

We can confirm this contrast between *buy* and *sell* by examining their behavior as complements of *participate*. The verb *participate* seems to favor quite strongly the logical subject of the event associated with its complement nominalization. So compare (8.74a) and (8.74b):

(8.74a) LaToya participated in the purchase of the studio.

(8.74b) LaToya participated in the sale of the studio.

In spite of what we might initially conceive of as the semantics of *participate*, I believe that in (8.74a), LaToya can be construed as one of the buyers or an agent or associate of the buyer, but cannot be construed as the seller. Conversely, in (8.74b), LaToya can be construed with the seller but not the buyer.[26] Given that the complement nominalization is a maximal projection which does seem to enter into a control relationship with the matrix subject, I can think of no explanation for this contrast except the lexical properties of deep arguments of the predicates *purchase* and *sell*. It seems, then, that the entire range of linguistic evidence justifies distinguishing between these two verbs.

It is important to note that there is nothing external to the evidence from modification and patterns of inference which yields this result; I have reached no "ontologically correct" conclusion, nor have I attempted to. All I need to show is that it is *consistent* to assume that buying and selling events are linguistically distinguished. Of course, merely by demonstrating that the denotation of *murder* is a subset of the denotation of *kill*, and that the denotations of *buy* and *sell* are disjoint, I have certainly not demonstrated that each event maps to one and only one sequence of participants. For example, because the modification possibilities for states is rather impoverished, there may be some problem demonstrating that *fear* and the stative sense of *frighten* are distinct, since if one individual fears another, the second frightens the first, and vice versa. Nevertheless, I think there is sufficient motivation for, and no counterevidence to, assuming the functionhood of G.

8.5.3 Reviewing Davidsonian elements

At this point, we can review the properties of Davidsonian elements which we have uncovered. In Chapter 2, I entertained the following candidates for Davidsonian elements:

- times and locations
- worlds and propositions
- situations
- other, unanalyzed primitive individuals

- properties of moments of time
- complex objects, perhaps situations annotated with distinguishing information

I rejected worlds and propositions immediately; I argued extensively against times and locations; I retained situations, primitive individuals and complex objects as possibilities. I did not discuss properties of moments of time, but I believe that the granularity of such properties cannot be finer than that of situations; so for instance, since buying and selling events are necessarily cotemporaneous, they cannot be distinguished even in an intensional account such as this one.

In this study, I put forward two major proposals about Davidsonian elements. First, I observed in Chapter 3 that if we hoped to subsume Davidsonian elements under e-conjunction, Davidsonian elements had to inhabit a lattice-theoretic structure parallel to that of individuals. We also saw that the definition of summativity in (3.58) applied to Davidsonian denotations required a notion of lattice-theoretic join for events. Finally, if we are to extend the techniques for applying cardinal modifiers to nonatomic individuals to the account of frequency adverbials like *twice*, the notion of a set of atomic events (and thus a lattice-theoretic part structure) is crucial. These parallels with the domain of individuals might well favor situations and primitive events, both of which are subsets of the domain of individuals, over complex objects as Davidsonian elements.

Second, I observed that events must be fine-grained. We saw in this chapter that the facts of verbal modification and adverbial orientation demanded that we distinguish between buying and selling events, which rules out Kratzer-style situations (as well as properties of moments of time) as candidates for Davidsonian elements. I also assumed a conservative account of lattice structure, one which identifies atoms not with respect to a particular property or predicate but in absolute terms, and observed in Chapter 5 that such an assumption seems incompatible with the choice of situations as Davidsonian elements.

As I stated in Chapter 2, I will not reach a conclusion about the actual identity of the Davidsonian element. My suspicion is that the most insightful account will be in terms of complex objects corresponding to aspects of or views on situations. I will leave this issue for further research.

8.5.4 *Remaining problems*

8.5.4.1 Coordination and construal

The problem with assuming a lexical basis for construal with logical subjects in Passive is that it presents problems for construal with coordinated verbs. Thomason and Stalnaker (1973) discuss these cases in the context of passive-sensitive adverbials, and Bach (1980) mentions them in the context of the Passive *by*-phrase:

(8.75a) LaToya was reluctantly praised and encouraged.
(8.75b) LaToya was praised and encouraged by Michael.

The reading I'm concerned with here is the one in (8.75a) in which both the praising and encouragement are reluctantly performed by the praiser and encourager, and the one in (8.75b) where Michael does both the praising and encouraging. If we assume the Lasersohn's account of coordination outlined in Chapter 3, then the denotation of these sentences is as follows:

(8.76a) $[\![\text{LaToya was reluctantly praised and encouraged}]\!] =$
$$\lambda e[\exists e' \exists e''(e = e' + e'' \wedge reluctant'(\pi_1(G(e)))(e) \wedge \exists x(praise'(l)(x)(e')) \wedge \exists x(encourage'(l)(x)(e'')))]$$
(8.76b) $[\![\text{LaToya was praised and encouraged by Michael}]\!] =$
$$\lambda e[\exists e' \exists e''(e = e' + e'' \wedge \pi_1(G(e)) = m \wedge \exists x(praise'(l)(x)(e')) \wedge \exists x(encourage'(l)(x)(e'')))]$$

The problem is: what does it mean to apply G to an event which is the sum of two events which are members of different lexical denotations? We could attempt to define G for complex events in terms of summativity:

(8.77) $G(e_1 + e_2) = G(e_1) + G(e_2)$

Here the model-theoretic join of two participant sequences is equivalent to their pairwise join. The problem is that this definition can only hold for participant sequences of identical lengths, but we find the same construal for coordinated passive IVs which correspond to lexical predicates of differing valence:

(8.78) LaToya was reluctantly praised and given an award.

Of course, what's important is not the pairwise join of the entire participant sequences, but simply the join of the logical subjects. However, I have not come up with a way to isolate that in a principled manner. Furthermore, it's possible that the praiser and the encourager in (8.75a) are different people, but in that case we would have to assume that *reluctantly*, and all adverbs like it, are distributive on their first argument, since by asserting that the join of these two individuals is reluctant in *e*, we must mean that each of them is reluctant. But then we lose the dependency between the praiser and the praising event, and between the encourager and the encouraging event, because all we know is that there is *some* part of *e* in which each is reluctant, but not which part.

In other words, it's clear that the notion of logical subject plays the crucial role in determining adverbial construal, but the formalization of this construal I've provided leaves something to be desired.

8.5.4.2 Carlson and *leave alone*

Let's return to Carlson's discussion of *leave alone* in Chapter 7. Carlson argues that agentless Passive *leave alone* entails that the subject was left alone by everyone, while the addition of a *by*-phrase "cancels" this entailment:

(8.79a) LaToya was left alone.
(8.79b) LaToya was left alone by Michael.

I recounted Dowty's argument that the facts of agentless Passive *leave alone* did not support an account of thematic roles; however, it does have intriguing implications for my account of Passive. If the *by*-phrase is an argument, as Dowty (1982) maintains, then the account of *leave alone* is straightforward: the agentless Passive subcategorization has a meaning which requires the subject to be left alone by everyone, while the agentive Passive subcategorization bears no such requirement. The semantics of the agentless Passive is not predicted by the rule of Agentless Passive, but this is not a problem for the account of word meaning put forward in Dowty (1979).

If the *by*-phrase is a modifier, on the other hand, matters are a little more complex. Passive *leave alone* will still have two meanings; but how those meanings are paired with the appropriate array of complements is not completely obvious. It can't be that Passive *leave alone* is simply ambiguous between "be left alone by someone" and "be left alone by everyone", because we must account for why the agentless Passive does not have the existential reading. Presumably, we must assign the agentless subcategorization the universal reading, and introduce an exceptional subcategorization which requires the *by*-phrase which bears the existential reading.[27] However, if the *by*-phrase is a modifier which occurs with agentless Passives, we must somehow keep it from modifying the agentless Passive *leave alone*, since (8.79b) never means that LaToya was left alone by everyone, Michael in particular.

So what constrains this cooccurrence? The constraint cannot be semantic, because the agentless universal interpretation is *consistent* with the specific reading associated with an explicit *by*-phrase; in fact, it entails it. In other words, if we interpret *leave alone* universally, the *by*-phrase in (8.79b) is redundant, at worst. One obvious option is to block the occurrence of the *by*-phrase syntactically. This option is not entirely *ad hoc*, since some mechanism need to block the occurrence of multiple *by*-phrases anyway:

(8.80) *Jermaine was kissed by his brother by Michael.[28]

Agentless Passive *leave alone* simply comes with the feature that blocks the *by*-phrase already "turned on." However, this solution is compromised by the fact that we have already seen in Section 7.2.3.3 that we independently require some constraint that within a single sentence, no two participant-denoting constituents bear the same thematic role to the same head. So presumably, we need no specific syntactic account here. I have no solution for this puzzle, and I will leave it for further research. *leave alone*

8.6 Conclusion

In this chapter, I have attempted to show that at least one group of phenomena which some have argued are sensitive to thematic roles are actually sensitive to deep grammatical structure instead. I have presented an account of such sensitivity, supported by arguments for the relative fine-grainedness of events.

Notes

[1]This generalization is intended to apply to adverbials and adjectives which are standardly regarded as modifiers. This generalization is compromised by a number of factors. For instance, no adverbial is completely free in its range of possibilities. Locative adverbials cannot modify placeless states, temporal adverbials cannot modifier timeless states, directional adverbials are restricted to verbs of physical or abstract motion, and manner adverbs have similarly detailed restrictions on their compatibility with types of events:

(ia) *Two plus two equals four in the living room.
(ib) *The river follows the road at 4 PM.
(ic) *Jermaine stood into the garage.
(id) *Janet collapsed from fatigue by limping across he finish line.

Similarly, scalar modifiers like *quick* and *quickly* are (contextually) dependent on their heads to provide a reference set for the scalar evaluation. I hope I have hedged my criterion enough to describe the intended distinction (and illustrate its vagueness).

[2]Thanks to Jacobson (p.c.) for reminding me of this fact. I am not sure what the explanation for this contrast is; although it seems that in the licit examples here, the initial manner adverb has scope over the final manner adverb, it is somewhat mysterious why this can't happen in VP-final sequences, especially since VP-final adverbials are not blocked from exhibiting scope relationships with each other:

(i) Michael performed a concert on every continent in front of a head of state.

Nor is it clear why VP-final manner adverbials could not cooccur without one having scope over the other, since coordinations of VP-final adverbials are impeccable:

(ii) LaToya slapped Michael carelessly and cruelly.

[3]I will ignore the sortal restriction on the adverbial argument to adverbs of direction, since I have no account of sortal restrictions.

[4]I will clarify what I mean by referring to an argument position in a moment.

[5]It seems that in the Passive case, the deep subject is much more accessible to the adverbial modifier if the *by*-phrase is present. I have no explanation for this.

[6]There is a subclass of this second class of adverbs which can be construed with Passive subjects either with difficulty or not at all. One instance of this subclass is *vigorously*:

(ia) Vigorously, LaToya pursued Jermaine. (LaToya is vigorous)
(ib) Vigorously, Jermaine was pursued by LaToya. (LaToya is vigorous)

Whether or not this class of adverbs is a distinct class from the passive-sensitive adverbials is a matter of debate. On the one hand, either participant could be interpreted as participating vigorously in the pursuit, independent of whether that participant was the pursuer or the pursued, so we must explain the absence of the relevant logical possibilities; on the other hand, there could be something very subtle about the semantics of *vigorously* and the semantics of *pursue* which interact to constrain the possibilities for construal which has nothing to do with argument structure and everything to do with real-world constraints on these predicates. While this issue is actually quite relevant to the course of my argument, the precise status of this subclass of adverbs is not, so I will ignore them.

[7]My source for this claim, and all others originating in Keenan and Faltz (1979), is Keenan (1980). The only exception they note to their generalization is Acehnese, the analysis of which is still in dispute.

[8]Notice, interestingly, that the *by*-phrase must be licensed by an auxiliary which subcategorizes for a Passive VP:

(i) *LaToya was insulted by Jermaine, and Michael will by Janet.

[9]The generalization that VP ellipsis does not strand arguments may be compromised by noncomparative cases of Pseudo-Gapping, reported by Hoeksema (1991). These examples demonstrate that while most complements cannot be stranded by Pseudo-Gapping, direct objects can be:

(ia) Why *wouldn't* America elect Quayle president? We did Bush.
(ib) *Why *wouldn't* America elect Quayle president? We did vice-president.

However, it's worth noting that the stranding here does not generalize to any internal argument besides the NP object, and that the goodness of such examples degrades significantly in the presence of an auxiliary other than *do*:

(iia) *Why *wouldn't* America believe that the Bill of Rights is outdated? We do that affirmative action is wrong.
(iib) *Why *wouldn't* America elect Quayle president? We might Buchanan.

An analysis of Pseudo-Gapping is beyond the scope of this thesis. The evidence suggests that it is a different phenomenon than VP ellipsis, though, and so I conclude that the generalization that VP ellipsis does not strand arguments can be maintained.

[10]This analysis raises the question of what the correspondence is between the denotation of the nominalization and the denotation of the verb. In Chapter 7, I argued that Dowty's (1989) arguments support parallels between nouns and verbs more than they support contrasts; however, providing a further analysis of this relationship is beyond the scope of this study.

[11]This ambiguity of referral translates into a two-part analysis in every approach I have found, including my own, so I will not dwell on this contrast too much.

[12]The surface subject is not reluctant in this case, but this is presumably a straightforward selectional clash.

[13]This list is culled from Dowty (1991) and Goldberg (1995).

[14]The asymmetries involved in this class of predicates is also discussed by Gawron (1988).

[15]Interestingly, arguments which map in the other direction seem to be almost nonexistent. The prefix *out-* does not seem to have any productive opposite. The closest I can find is *under-*, but *under-* typically compares a participant to a standard, not to an analogous participant. This is a characteristic shared by some instances of *out-*, as well as cases of *over-*:

(ia) This stock underperformed the market.
(ib) My brother outgrew his tuxedo.
(ic) That automobile is overpriced.

In the few cases where *under-* compares two participants, it seems to be that the lower score "wins". So LaToya can underbid Michael for a service contract (and win the contract), but she can't underbid him for the antique jukebox (and thus lose the jukebox). The past participle *undersold* (as in the famous *We will not be undersold*) seems to work the same way. This generalization is discussed by Gawron (1988), who also provides as an example the verb *dwarf*, which does not have the anticipated meaning "to be smaller than".

[16]Now, one might conclude that this analysis cannot be taken to be a complete account of manner adverbs such as *vigorously* on the grounds that *vigorously* can modify weather verbs like *rain*, which seem to have no referential logical or surface subject:

(i) It rained vigorously.

However, if these examples are a problem for a theory of argument construal, they're also a problem for thematic role accounts, since if *rain* has no referential logical or surface subject, it has no thematic roles either. Furthermore, as pointed out to me by Jacobson (p.c.), there are actually reasons to believe that the *it* subject of weather verbs is a genuine argument; for instance, it may participate in control constructions:

(ii) It's too cold to snow.

[17]According to Landman, these proposals are in line with an idea of Schwarzschild's that adverbial orientation is always semantic, never syntactic; however, I cannot find the reference to which Landman refers.

[18]Landman (p.c.) informs me that the reason for this contrast is so that he can adopt the properties of plurals without needing to redefine all the notions involving predicates.

[19]In other words, quantification is restricted in the same sense that set formation is.

[20]Dekker (1993) tried to address this problem via dynamic existential disclosure of such argument positions (cf. Section 5.2.2), but Dekker's approach introduces an unacceptable degree of ambiguity.

[21]I will be ignoring wrap in this derivation.

[22]Landman claims that these adverbials are intensional in some ways (a claim which I think is mistaken), but the meanings he assigns to them do not involve scope contrasts.

[23]I will not concern myself with the details of a feature system at this point. I will also not concern myself with the complications of passives of ditransitives.

[24]I do not intend to imply that *be* is several ways ambiguous because of its range of subcategorization possibilities. Morrill (1990; 1992) and Bayer (1996) introduce category disjunction as a direct means of encoding subcategorization possibilities into a single functional category.

[25]Jacobson (p.c.) is not as certain of these judgments as I am, interpreting the construal here as a strong tendency rather than a requirement. She proposes that more "transparent" nominalizations provide sharper intuitions:

(ia) LaToya participated in the buying of the condo.
(ib) LaToya participated in the selling of the condo.

Jacobson points out that if this contrast is accurate, this might provide more evidence about the properties and transparency of nominalization, discussed in Section 7.2.3.1.

[26]If this analysis were to pan out, this predicate would be an example of a *by*-phrase as an "exceptional" obligatory modifier, an expected case we could not document in Section 8.2.3 above.

[27]Except on the (irrelevant) appositive meaning.

Chapter 9

Conclusion

The interactions between events, participation, plurality, quantification, and distributivity have generated enormous attention in semantics in the last few years. These issues seem to be very tightly related, yet we are only beginning to understand the nature of these relationships. In this study, I have attempted to show that we can bring a wide range of tools to bear on the question of which compositional model of participation, Davidsonian or neo-Davidsonian, is justified by the facts of sentence semantics. I have concluded that the Davidsonian strategy is justified, and the neo-Davidsonian strategy is not.

I began with the fundamentals: justifying events, modeling plurality and distributivity, relating plurals and quantification. I then demonstrated that while the task was not completely straightforward, it was possible to model our understanding of distributivity and quantification in a Davidsonian model. I then turned to the neo-Davidsonian alternative, and carefully distinguished between adopting the neo-Davidsonian compositional strategy and simply adopting thematic roles. I argued that the neo-Davidsonian compositional alternative was not justified by the data, and that the neo-Davidsonian lexical account was compositionally indistinguishable from the Davidsonian account. That is, if thematic roles are relevant to semantics at all, they are relevant to lexical semantics. not compositional semantics. I concluded by showing that generalizations about logical subjecthood could be derived, under the appropriate circumstances, without reference to a level of thematic roles.

Thematic roles are a resource which has commanded tremendous intuitive appeal throughout the history of linguistics. Dowty (1991) traces their pedigree back to Gruber and Fillmore and, ultimately, Pāṇini. The reason for this appeal is obvious. Thematic roles imply a promise to bundle up all the semantic considerations which are relevant to syntax in a neat package, and these considerations (volitionality, causation, etc.) arise over and over in generalizations about languages. It is undeniable that in this process, only a small set of distinctions are relevant; the universal principles which guide the determination of verbal argument structure are sensitive to properties like volitionality and causation, not properties like the relative size or age of the participants. Dowty (1991) and Gawron (1988) discuss some of these properties in great detail. Nevertheless, I think there are a number of reasons to resist the temptation to adopt thematic roles.

First, thematic roles are neither discrete nor monolithic; as Dowty has shown, the properties which make up the "canonical" *Agent* or *Patient* are almost never all simultaneously present, and even when only one such property is present, it has the potential to have linguistic consequences for argument mapping. Second, language exhibits a tremendous facility for imposing asymmetries on the world, and the granularity of broad thematic roles cannot do justice to the range of asymmetries we are able to perceive. Dowty shows that many distinctions among argument positions cannot be made in terms of traditional thematic roles; indeed, we encountered the same situation when we examined the class of *out-* verbs in Chapter 8, which is an extreme example of parallels being ignored and asymmetries emphasized in the process of grammaticizing chunks of the world. Third, if thematic roles are basic relations, we cannot perceive them directly; the only way we can determine agency is by observing properties such as causation, volitionality, etc., that is, by perceiving the fundamental properties which constitute these purported thematic roles. Finally, if we bundle up sets of these properties as thematic roles, all we're doing is institutionalizing the most frequent or typical bundles, with the result that the noncanonical cases are rendered unnecessarily mysterious and difficult to deal with, as Dowty abundantly demonstrates.[1]

The nature of the linguistic dependency between participants and events is still at issue, I believe. For instance, I've said little about the dependencies between event nominalizations and their complements, except to argue that they do not support the compositional neo-Davidsonian alternative. However, nominal dependencies clearly differ from verbal dependencies in crucial ways, ways which I think we have yet to discover, much less adequately characterize. Furthermore, while I have argued that verbal dependencies for core syntactic arguments are straightforwardly order-based, I have also argued that this result is a very shallow one. In many ways, this study is a lesson about what model-theoretic semantic composition is: namely, a specifically linguistic way of conceiving of relationships in the world. Even if thematic roles do exist, they are too semantically "deep" to be relevant to semantic composition anyway. And the relationship between this shallow level and the deeper ontologies which underlie cognition is perhaps the largest and most difficult question.

Notes

[1]In a similar vein, Krifka (p.c.) suggests that active languages like Guarani in which case marking on intransitives splits and transparently reflects a semantic contrast between agent-like and patient-like argument properties (cf. Mithun (1991) and references therein), may favor a thematic role account over an ordered-argument account. I disagree. The discussion in Mithun (1991) demonstrates clearly that it is the properties which thematic roles are typically constructed out of, rather than the roles themselves, which determine case marking in these languages. There is no reason to believe that the fact that the morphology is transparently sensitive to the entailments associated with a given argument position implies that thematic roles in the familiar sense are relevant to the analysis of these languages in any way. Dowty (1991) discusses a closely related issue in the context of the unaccusative hypothesis.

Appendix A

Neo-Davidsonian VP Coordination

In Chapter 6 above, I observed that Krifka's account of neo-Davidsonian composition exhibits fatal problems when confronted with VP coordination. However, I did not document this problem in sufficient detail. In this appendix, I will return to this issue, and show that neither of this account nor Krifka's earlier account can handle this phenomenon, each for different reasons.

A.1 The first problem

I will begin with a discussion of the account of Krifka (1992), which I described in detail in Chapter 6. In this account, Krifka assumes that NPs, rather than verbal projections, bear the burden of establishing the NP's participant function, and that NPs fill the appropriate argument positions of verbs because of syntactic features which correspond one-to-one with thematic roles. I repeat (6.20) to illustrate:

(6.20)

$$\dfrac{\dfrac{\text{drink}}{(\text{V/NP}[\textit{agent}])/\text{NP}[\textit{patient}],\ drink'} \qquad \dfrac{\text{some water}}{\text{NP}[\textit{patient}],\ \lambda Q\lambda e[\exists x(water'(x) \wedge PAT(e,x) \wedge Q(e))]}}{\textbf{FA}\text{: V/NP}[\textit{agent}],\ \lambda e[\exists x(water'(x) \wedge PAT(e,x) \wedge drink'(e))]}$$

As we can see here, the syntactic category of the VP encodes the thematic role feature of its expected subject, in the same way the transitive verb here encodes the thematic role feature of its expected object. Determiners encode the correspondence between thematic role features and thematic roles; I presume (although Krifka does not say) that an analogous process holds for proper nouns. I illustrated this second process in (6.21), repeated here:

(6.21)

$$\dfrac{\dfrac{\dfrac{\text{LaToya}}{\text{NP},\ l} \qquad \dfrac{}{\text{NP}[agent]/\text{NP},\ \lambda x \lambda Q \lambda e[AGENT(e,x) \wedge Q(e)]}}{\textbf{FA}: \text{NP}[agent],\ \lambda Q \lambda e[AGENT(e,l) \wedge Q(e)]} \qquad \dfrac{\text{drank}}{\text{V/NP}[agent],\ drink'}}{\textbf{FA}: \text{V},\ \lambda e[AGENT(e,l) \wedge drink'(e)]}$$

The problem arises when we turn to VPs with differing thematic role features whose verbs bear the same array of thematic roles:

(A.1) Michael entertained in Vegas and was reviewed favorably.

(A.2) $\langle$"entertain", V/NP[*agent*], $entertain'\rangle$

(A.3) $\langle$"be reviewed", V/NP[*patient*], $review'\rangle$

So the verbs *entertain* and *review* each assign *Agent* and *Patient* roles, and the role the projected VP assigns is determined by the voice of the verb. I will argue in this section that the syntax and semantics of coordination can only implausibly be made to express the appropriate reading in Krifka's account.

The first, and perhaps least troublesome, obstacle is that because the thematic role features of their arguments differ, the syntactic categories of the VPs *entertain* and *be reviewed* differ as a result. However, the coordination schema typically assumed in Categorial Grammar demands identity of syntactic category:

(A.4) $\langle$"and", $(\alpha/_{\mathrm{L}}\alpha)/_{\mathrm{R}}\alpha,\ \&\ \rangle$

Recent work in the coordination of unlike categories address this concern (Sag *et al.* (1985), Morrill (1990; 1992), Bayer (1996), Bayer and Johnson (1995)). Bayer (1996), in particular, provides a Categorial Grammar account which unifies a number of disparate phenomena under the rubric of the coordination of unlikes, exploiting Morrill's Boolean category connectives $\wedge$ (called *meet*) and $\vee$ (called *join*). The behavior of these connectives is grounded in an interpretation of category combination as inference in the Lambek tradition, as explicated in Bayer and Johnson (1995).

For instance, if we regard an atomic category A as a *premise*, and regard a complex category B/A as an implication with A as its *antecedent* and B as its *consequent*, the rule of Function Application becomes a rule of *modus ponens* of a sort; Function Application tells us that if we are given a category which allows us to deduce a B given an (adjacent) A, and we're given an (adjacent) A, then we may deduce a B. In such a framework, the Boolean connectives $\wedge$ and $\vee$ have their expected interpretations in the logic. So if we have a category which allows us to infer a B given an A, and we're given an A $\wedge$ C, we ought to be able to infer a B, since in some sense, we "know enough". There are two ways to approach this derivation. First, we observe that A $\wedge$ C ought to allow us to infer A (and similarly, A ought to allow us to infer A $\vee$ C). I call this rule of inference *Premise Weakening*:[1]

(A.5a) Premise Weakening A:
$$\langle \sigma, \mathrm{A}, m_{TYP(\mathrm{A})} \rangle \rightarrow \langle \sigma, \mathrm{A} \vee \mathrm{B}, m \rangle$$
(A.5b) Premise Weakening B:
$$\langle \sigma, \mathrm{A} \wedge \mathrm{B}, m_{TYP(\mathrm{A})} \rangle \rightarrow \langle \sigma, \mathrm{A}, m \rangle$$

Second, we can observe that any complex category which allows us to infer B given an A ought to allows us to infer B given something stronger than A. That is, while premises are weakened, antecedents are strengthened:[2]

(A.6a) Antecedent Strengthening A:
$$\langle \sigma, \mathrm{A/B}, m_{TYP(\mathrm{A/B})} \rangle \rightarrow \langle \sigma, \mathrm{A/(B} \wedge \mathrm{C)}, m \rangle$$
(A.6b) Antecedent Strengthening B:
$$\langle \sigma, \mathrm{A/(B} \vee \mathrm{C)}, m_{TYP(\mathrm{A/B})} \rangle \rightarrow \langle \sigma, \mathrm{A/B}, m \rangle$$

The application of either of these rules in the situation described will feed Function Application in the expected way.[3]

What is the interpretation of the constituent which bears this derived category? Morrill assumes two versions of his Boolean connectives, one semantically *potent* and one semantically *non-potent*. In the semantically potent case, Boolean conjunction corresponds to pair formation in the semantics, and disjunction corresponds to operators over such pairs; in the non-potent case, both these operators induce no change in the semantics. Bayer (1996) argues that all the available evidence points to the exclusive use of the non-potent Boolean connectives, and I will make this assumption initially here as well.

Either Premise Weakening or Antecedent Strengthening will allow us to adjust complex categories whose antecedents differ in order to conjoin them. However, the rule of Antecedent Strengthening allows the result to feed Function Application, so we will choose this second strategy. I will assume Lasersohn's version of generalized sum conjunction throughout:

(A.7)

entertain	and	be reviewed
V/NP[*agent*], $entertain'$	$(\alpha/_{\mathrm{L}}\alpha)/_{\mathrm{R}}\alpha$	V/NP[*patient*], $review'$
V/(NP[*agent*] $\wedge$ NP[*patient*]), $entertain'$		V/(NP[*agent*] $\wedge$ NP[*patient*]), $review'$
	FA: ...	
FA: V/(NP[*agent*] $\wedge$ NP[*patient*]), $entertain'$ & $review'$		

So there is at least a technique to allow the constituents to conjoin in the syntactic dimension.

So what does the conjunction mean? Since both $entertain'$ and $review'$ are sets of individuals, the resulting interpretation is a set of complex individuals which can be decomposed into entertain events and review events (cf. Section 3.6):

(A.8) $entertain' \,\&\, review' =$
$$\lambda e[\exists e_1 \exists e_2(e = e_1 + e_2 \wedge entertain'(e_1) \wedge review'(e_2))]$$

We now turn to the NP *Michael*. The category of *Michael* must be somehow end up as a NP[*agent*] $\wedge$ NP[*patient*]. Furthermore, this category must be "born" as a conjunction for two reasons: first, no valid rule of inference can infer $a \wedge b$ given only a, and second, thematic role features have semantic reflexes in the meaning of the NP, because they correspond to thematic roles. While it seems a little odd to permit a semantically non-potent Boolean category operation to manipulate these features on verbs, it is almost certainly inappropriate to do the same on nouns. Thus, we must assume that in addition to the sort of proper noun shifter found in (6.21), we must also employ shifters which introduce conjunctions of thematically-marked categories.

But what is the interpretation of *this* constituent? It must indicate that *Michael* is both an agent and a patient, but *Michael* is an agent and patient of *different events*. Let's try to encode this fact in our shifter:

(A.9)

$$\dfrac{\dfrac{\text{Michael}}{\text{NP}, j} \qquad \dfrac{}{\begin{array}{c}(\text{NP}[agent] \wedge \text{NP}[patient])/\text{NP},\\ \lambda x \lambda Q \lambda e[\exists e_1 \exists e_2(e = e_1 + e_2 \wedge Q(e) \wedge \\ AGENT(x, e_1) \wedge PATIENT(x, e_2))]\end{array}}}{\begin{array}{c}\textbf{FA: } \text{NP}[agent] \wedge \text{NP}[patient],\\ \lambda Q \lambda e[\exists e_1 \exists e_2(e = e_1 + e_2 \wedge Q(e) \wedge \\ AGENT(j, e_1) \wedge PATIENT(j, e_2))]\end{array}}$$

But this meaning is not going to be precise enough. It does not guarantee, for instance, that Michael is the entertainer and the one reviewed, as opposed to the one entertained and the reviewer:

(A.10)

$$\dfrac{\dfrac{\text{Michael}}{\begin{array}{c}\text{NP}[agent] \wedge \text{NP}[patient],\\ \lambda Q \lambda e[\exists e_1 \exists e_2(e = e_1 + e_2 \wedge Q(e) \wedge \\ AGENT(j, e_1) \wedge PATIENT(j, e_2))]\end{array}} \qquad \dfrac{\text{entertain and be reviewed}}{\begin{array}{c}\text{V}/(\text{NP}[agent] \wedge \text{NP}[patient]),\\ \lambda e[\exists e_3 \exists e_4(e = e_3 + e_4 \wedge \\ entertain'(e_3) \wedge review'(e_4))]\end{array}}}{\begin{array}{c}\textbf{FA: } \text{V},\\ \lambda e[\exists e_1 \exists e_2(e = e_1 + e_2 \wedge \\ \exists e_3 \exists e_4(e = e_3 + e_4 \wedge entertain'(e_3) \wedge review'(e_4)) \wedge \\ AGENT(j, e_1) \wedge PATIENT(j, e_2))]\end{array}}$$

That is, we know that each event in this set of events is the sum of an entertain event and a review event, and we know that each event is the sum of an event of which Michael is the Agent and an event of which Michael is the Patient, but we have no idea how the two correspond to each other.

So what is the source of this problem? It seems that if the NP is to encode the semantic force of thematic roles, then "parts" of the VP denotation have to be made to correspond to "parts" of the NP denotation. In other words, the denotations of these constituents cannot be the monolithic objects which are commonly assumed in model-theoretic semantics; we must be able to "look inside" them in some way. There are a number of strategies which support such a revision. One of them involves *structured meanings*, objects whose internal structure is visible to subsequent semantic operations. This sort of structure is different from the structure of the semantic dimension of the neo-Davidsonian alternative I presented in Chapter 6. The semantic dimension of constituents in that proposal has internal structure, to be sure; however, no further internal structure is *created* in the course of the derivation. A structured meanings approach has the potential to increase the internal complexity of semantic objects as the derivation progresses.

One such account is Morrill's account of semantically potent Boolean category connectives. The uses of the Boolean connectives in Morrill's account parallel those in Bayer (1996). Premise join categories and antecedent meet categories are derived to feed generalized conjunction, as we saw in (A.7) above. However, the semantics of the operations of Premise Weakening and Antecedent Strengthening will no longer be identity. Before I continue, I wish to adopt my first revision of Krifka's account, articulated in Chapter 6. This revision parallelizes the conceptual direction of Function Application between syntax and semantics. As an illustration, I repeat (6.24):

(6.24)

LaToya		drank
NP, l	(V/(V/NP[*agent*]))/NP,	V/NP[*agent*],
l	$\lambda x \lambda Q \lambda e[AGENT(e,x) \wedge Q(e)]$	$drink'$

FA: V/(V/NP[*agent*]), $\lambda Q \lambda e[AGENT(e,l) \wedge Q(e)]$

FA: V, $\lambda e[AGENT(e,l) \wedge drink'(e)]$

In this account, the subject is the functor in both the syntax and the semantics. Given this backdrop, how might we employ Morrill's semantically potent connectives?

Let's begin with (some of) the rules of Premise Weakening:

(A.11) Left Premise Weakening:
$\langle \sigma, \mathrm{A}, m_{TYP(\mathrm{A})} \rangle \rightarrow \langle \sigma, \mathrm{A} \vee \mathrm{B}, \lambda\pi[\pi_{left}(\pi)(m)] \rangle$

(A.12) Right Premise Weakening:
$\langle \sigma, \mathrm{B}, m_{TYP(\mathrm{B})} \rangle \rightarrow \langle \sigma, \mathrm{A} \vee \mathrm{B}, \lambda\pi[\pi_{right}(\pi)(m)] \rangle$

Recall that I said above that semantically potent Boolean conjunction corresponds to pair formation, while disjunction corresponds to operators over such pairs. Here π is a variable over semantic pairs, and π_{left} and π_{right} are functions from pairs to the left and right dimension, respectively. What will distinguish this account from the semantically non-potent account is the fact that because the pairs in question are crucially ordered, the meaning of A $\wedge$ B is not necessarily equivalent to the meaning of B $\wedge$ A. As a result, we will be able to "keep track" of which thematic role corresponds to which verb.

So if we conjoin *entertain* and *be reviewed* now, we get a different result. Before, I presented a derivation of VP conjunction involving Antecedent Strengthening, because the resulting conjunction needed to be functor. Given my revision of Krifka's account presented in (6.24), the resulting VP conjunction is going to be an argument, not a functor. Therefore, I will focus on the derivation involving Premise Weakening:

(A.13)

$$\dfrac{\dfrac{\dfrac{\text{entertain}}{\text{V/NP}[agent],\ entertain'}}{\text{V/NP}[agent] \vee \text{V/NP}[patient],\ \lambda\pi[\pi_{left}(\pi)(entertain')]} \qquad \dfrac{\dfrac{\text{and}}{(\alpha/_{\text{L}}\alpha)/_{\text{R}}\alpha} \qquad \dfrac{\dfrac{\text{be reviewed}}{\text{V/NP}[patient],\ review'}}{\text{V/NP}[agent] \vee \text{V/NP}[patient],\ \lambda\pi[\pi_{right}(\pi)(review')]}}{\textbf{FA: }\ldots}}{\textbf{FA: }\text{V/NP}[agent] \vee \text{V/NP}[patient],\ \lambda\pi[\pi_{left}(\pi)(entertain')\ \&\ \pi_{right}(\pi)(review')]}$$

So the resulting meaning is a function over pairs. This meaning must interact appropriately with the functor it is an argument of; in addition to providing a pair as an argument, the functor meaning must be of the appropriate type to take a function over pairs as its argument.

In our example, *Michael* is the element which bears the thematic role ambiguity; as it does in my account, it will bear a meet category, but this meet category will correspond to a semantic pair, where each branch corresponds to a different thematic role. The type shifter itself must generate this structure. This is the pair which *entertain and be reviewed* expects. Furthermore, as I just noted, the overall meaning must take a function over pairs as its argument:

(A.14) Michael / NP, j — $(V/_R(V/_L NP[agent] \vee V/_L NP[patient]))/NP$,
$\lambda x\lambda f[f(\langle\lambda Q\lambda e[Q(e) \wedge AGENT(x,e)], \lambda Q\lambda e[Q(e) \wedge PATIENT(x,e)]\rangle)]$

FA: $V/_R(V/_L NP[agent] \vee VP/_L NP[patient])$,
$\lambda f[f(\langle\lambda Q\lambda e[Q(e) \wedge AGENT(j,e)], \lambda Q\lambda e[Q(e) \wedge PATIENT(j,e)]\rangle)]$

As I mentioned previously, A $\wedge$ B is not equivalent to B $\wedge$ A in the semantically potent account; the internal order of the pair is significant. This order-dependence cashes out in the semantics of *entertain and be reviewed*, which accesses both dimensions of the pair in different places. We now combine the NP and VP:

(A.15)
$$\begin{aligned}
&\lambda f[f(\langle\lambda Q\lambda e[Q(e) \wedge AGENT(j,e)],\\
&\quad \lambda Q\lambda e[Q(e) \wedge PATIENT(j,e)]\rangle)]\\
&\quad (\lambda\pi[\pi_{left}(\pi)(entertain')\ \&\\
&\quad \pi_{right}(\pi)(review')]) =\\
&\lambda\pi[\pi_{left}(\pi)(entertain')\ \&\ \pi_{right}(\pi)(review')]\\
&\quad (\langle\lambda Q\lambda e[Q(e) \wedge AGENT(j,e)],\\
&\quad \lambda Q\lambda e[Q(e) \wedge PATIENT(j,e)]\rangle) =\\
&\pi_{left}(\langle\lambda Q\lambda e[Q(e) \wedge AGENT(j,e)],\\
&\quad \lambda Q\lambda e[Q(e) \wedge PATIENT(j,e)]\rangle)(entertain')\ \&\\
&\quad \pi_{right}(\langle\lambda Q\lambda e[Q(e) \wedge AGENT(j,e)],\\
&\quad \lambda Q\lambda e[Q(e) \wedge PATIENT(j,e)]\rangle)(review') =\\
&\lambda Q\lambda e[Q(e) \wedge AGENT(j,e)](entertain')\ \&\\
&\quad \lambda Q\lambda e[Q(e) \wedge PATIENT(j,e)](review') =\\
&\lambda e[entertain'(e) \wedge AGENT(j,e)]\ \&\\
&\quad \lambda e[review'(e) \wedge PATIENT(j,e)] =\\
&\lambda e[\exists e_1\exists e_2(e = e_1 + e_2 \wedge entertain'(e_1) \wedge AGENT(j,e_1) \wedge\\
&\quad review'(e_2) \wedge PATIENT(j,e_2))]
\end{aligned}$$

So Morrill's semantically potent Boolean connectives yield the appropriate result.

However, we must evaluate this result in the context of the overall effect of Morrill's account. As I said above, Bayer (1996) rejects a semantically potent account based on the observation that none of the phenomena discussed in the literature on the coordination of unlike categories actually justifies that account. In such circumstances, we might expect the semantically potent account to overgenerate, and indeed it does. For example, let's return to the Davidsonian account for a moment. In a way quite analogous to the account just outlined, Morrill's potent Boolean connectives will license an inappropriate derivation of *The sheep grazed and slept* where *sheep* is taken to be singular for one conjunct and plural for another. In such an account, the category of *the sheep* is NP[*singular*] $\wedge$ NP[*plural*], with a pair semantics corresponding to the set of atomic sheep in one dimension and the closure of that set in the other dimension. The Davidsonian VP *grazed and slept* will be modified by Antecedent Strengthening, which will introduce pair decomposition rules in a way very similar to the rules of Left and Right Premise Weakening above:

(A.16) $\langle$"graze and sleep", $V/_L(\mathrm{NP}[singular] \wedge \mathrm{NP}[plural])$,
$\lambda\pi\lambda e[graze'(\pi_{left}(\pi))(e) \;\&\; sleep'(\pi_{right}(\pi))(e)]\rangle$

I believe that the same problem would arise in Krifka's neo-Davidsonian account. While we would have to incorporate the additional complexity of thematic role features as well as number features, this would simply force us to proliferate type-shifting operations. In order to increase the plausibility of the resulting analysis by reducing the scope and number of these type-shifters, we might stipulate that only thematic role feature conflicts can induce semantically potent Boolean combination; however, there is no explanation for this particular exception to the generalization that semantically potent Boolean connectives are not needed, as argued in Bayer (1996). I would argue, then, that the cost of this solution for the remainder of the grammar is too high.

A.2 The second problem

There is another version of Krifka's account which is not susceptible to some of these criticisms. This account is described in Krifka (1989). However, this account as well has its costs and problems. In this account, it is the verb which encodes the semantic force of thematic roles, and the dependency between arguments and roles is enforced via free variables. I present here a version of (6.20) which exemplifies this alternative account:

(A.17)

some: NP_o/N, $\lambda P \lambda Q \lambda e[\exists x_o(P(x_o) \wedge Q(e))]$ — water: N, $water'$

FA: NP_o, $\lambda Q \lambda e[\exists x_o(water'(x_o) \wedge Q(e))]$

(A.18)

drink: $(\mathrm{V}/\mathrm{NP}_s)/\mathrm{NP}_o$, $\lambda e[drink'(e) \wedge AGENT(e, x_s) \wedge PATIENT(e, x_o)]$ — some water: NP_o, $\lambda Q \lambda e[\exists x_o(water'(x_o) \wedge Q(e))]$

FA: V/NP_s, $\lambda e[\exists x_o(water'(x_o) \wedge drink'(e) \wedge AGENT(e, x_s) \wedge PATIENT(e, x_o))]$

If I interpret Krifka correctly, he assumes a dependency between the syntactic index of the argument (encoded approximately by grammatical function) and the semantic index of the corresponding variable. We see from this derivation that this account works because the variables referred to in the NP and in the verb are identical; this identity is mediated, once again, by syntactic properties (in this case, the syntactic index). Although Krifka does not illustrate, I assume that the following is a representative derivation involving proper nouns:[4]

(A.19)

LaTova: NP, l — $\mathrm{NP}_s/\mathrm{NP}$, $\lambda x \lambda Q \lambda e[x = x_s \wedge Q(e)]$ — drank: V/NP_s, $\lambda e[drink'(e) \wedge AGENT(e, x_s)]$

FA: NP_s, $\lambda Q \lambda e[l = x_s \wedge Q(e)]$

FA: V, $\lambda e[l = x_s \wedge drink'(e) \wedge AGENT(e, x_s)]$

So how might the derivation of (A.1) proceed in this account? The first obstacle is Passive. We must ensure that the correspondence between variables and syntactic indices is maintained. Since the argument variables in the verbal denotation are free, we can't rebind them; thus, we must preserve the original syntactic indices. These indices, then, must be taken to correspond to "deep" grammatical relations. This assumption yields the following interpretations for *entertain* and *be reviewed*:[5]

(A.20) $\langle$"entertain", V/NP$_s$, $\lambda e[entertain'(e) \wedge AGENT(e, x_s)]\rangle$

(A.21) $\langle$"be reviewed", V/NP$_o$,
$\lambda e[review'(e) \wedge AGENT(e, x_s) \wedge PATIENT(e, x_o)]\rangle$

So we can conjoin these two VPs in the by-now-familiar way:

(A.22)

$$
\begin{array}{ccc}
\text{entertain} & \text{and} & \text{be reviewed} \\
\cline{1-1}\cline{2-2}\cline{3-3}
\text{V/NP}_s, & (\alpha/_{\text{L}}\alpha)/_{\text{R}}\alpha, & \text{V/NP}_o, \\
\lambda e[entertain'(e)\wedge & \& & \lambda e[review'(e) \wedge AGENT(e, x_s)\wedge \\
AGENT(e, x_s)] & & PATIENT(e, x_o)] \\
\cline{1-1}\cline{3-3}
\text{(A.6): V/(NP}_s \wedge \text{NP}_o\text{)}, & & \text{(A.6): V/(NP}_s \wedge \text{NP}_o, \\
\lambda e[entertain'(e)\wedge & & \lambda e[review'(e) \wedge AGENT(e, x_s)\wedge \\
AGENT(e, x_s)] & & PATIENT(e, x_o)] \\
\cline{2-3}
 & \multicolumn{2}{c}{\textbf{FA}: \ldots} \\
\hline
\multicolumn{3}{c}{\textbf{FA}: \text{V/(NP}_s \wedge \text{NP}_o\text{)},} \\
\multicolumn{3}{c}{\lambda e[entertain'(e) \wedge AGENT(e, x_s)]\ \&} \\
\multicolumn{3}{c}{\lambda e[review'(e) \wedge AGENT(e, x_s) \wedge PATIENT(e, x_o)]}
\end{array}
$$

This final meaning reduces as follows:

(A.23) $\lambda e[entertain'(e) \wedge AGENT(e, x_s)]\ \&$
$\lambda e[review'(e) \wedge AGENT(e, x_s) \wedge PATIENT(e_2, x_o)] =$
$\lambda e[\exists e_1 \exists e_2(e = e_1 + e_2 \wedge entertain'(e_1) \wedge AGENT(e_1, x_s) \wedge$
$review'(e_2) \wedge AGENT(e_2, x_s) \wedge PATIENT(e_2, x_o))]$

The most immediate problem, of course, is that it follows immediately in this account that both events have the same Agent, namely whatever the value of x_s is. This is a fatal problem. We must assume, then, that these two instances of x_s can be differentiated.

But if all argument positions of all verbs must be distinct, then the enumeration of indices is potentially enormous. This problem evokes the problem with Krifka's first account in the situation where we require individual thematic roles, as well as the intolerable degree of ambiguity required by Dekker's (1993) account of existential disclosure. Let us ignore this problem for the moment, and assume that the indices in question are differentiable:

(A.24) ⟨"entertain and be reviewed", V/($NP_{s1} \wedge NP_o$),

$$\begin{aligned} &\lambda e[\exists e_1 \exists e_2(e = e_1 + e_2 \wedge \\ &\quad entertain'(e_1) \wedge AGENT(e_1, x_{s1}) \wedge \\ &\quad review'(e_2) \wedge AGENT(e_2, x_s) \wedge PATIENT(e_2, x_o))]\rangle \end{aligned}$$

We can now shift the subject NP *Michael* into the appropriate type, modulo requiring a potentially enormous number of shifting rules to go along with the multiplicity of syntactic indices:

(A.25)

$$\dfrac{\dfrac{\text{Michael}}{\text{NP}, j} \qquad \dfrac{}{(\text{NP}_{s1} \wedge \text{NP}_o)/\text{NP},\ \lambda x \lambda Q \lambda e[x = x_{s1} = x_o \wedge Q(e)]}}{\textbf{FA: } \text{NP}_{s1} \wedge \text{NP}_o,\ \lambda Q \lambda e[j = x_{s1} = x_o \wedge Q(e)]}$$

We can see immediately that this derivation succeeds where Krifka's initial account failed, because the differentiation of indices has approximately the same effect as tracing role dependencies via semantically potent Boolean connectives:

(A.26)

$$\begin{aligned} &\lambda e[\exists e_1 \exists e_2(e = e_1 + e_2 \wedge \\ &\quad entertain'(e_1) \wedge AGENT(e_1, x_{s1}) \wedge \\ &\quad review'(e_2) \wedge AGENT(e_2, x_s) \wedge PATIENT(e_2, x_o))] \\ &\quad (\lambda Q \lambda e[j = x_{s1} = x_o \wedge Q(e)]) = \\ &\lambda e[j = x_{s1} = x_o \wedge \exists e_1 \exists e_2(e = e_1 + e_2 \wedge \\ &\quad entertain'(e_1) \wedge AGENT(e_1, x_{s1}) \\ &\quad \wedge review'(e_2) \wedge AGENT(e_2, x_s) \wedge PATIENT(e_2, x_o))] \end{aligned}$$

Although baroque, this derivation expresses the appropriate dependencies. Michael is the Agent of the entertain event and the Patient of the review event.

However, in addition to the above-mentioned problem with the number of shifting rules, this account makes the wrong predictions with respect to summativity. Consider an example like (A.27):

(A.27) Five people washed the windows and polished the floors.

The reading I intend is the summative reading, where the washing and polishing is accomplished by five people in total, but no commitments are made about the decomposition of tasks. Such an example is straightforward under a Davidsonian account which embraces generalized sum conjunction:

(A.28a) $[\![$five people$]\!] =$
$$\lambda E\lambda e[\exists x(people'(x) \wedge |x| = 5 \wedge E(x)(e))]$$

(A.28b) $[\![$wash the windows and polish the floors$]\!] =$
$$wash'(the{-}windows')\ \&\ polish'(the{-}floors')$$

(A.28c) $[\![$five people wash the windows and polish the floors$]\!] =$
$$\begin{aligned}
&\lambda E\lambda e[\exists x(people'(x) \wedge |x| = 5 \wedge E(x)(e))] \\
&\qquad (wash'(the{-}windows')\ \&\ polish'(the{-}floors')) = \\
&\lambda e[\exists x(people'(x) \wedge |x| = 5 \wedge [wash'(the{-}windows')\ \& \\
&\qquad polish'(the{-}floors')](x)(e))] = \\
&\lambda e[\exists x(people'(x) \wedge |x| = 5 \wedge \lambda y\lambda e'[\exists y_1\exists y_2(y = y_1 + y_2 \wedge \\
&\qquad [wash'(the{-}windows')(y_1)\ \& \\
&\qquad polish'(the{-}floors')(y_2)](e'))](x)(e))] = \\
&\lambda e[\exists x(people'(x) \wedge |x| = 5 \wedge \lambda e'[\exists y_1\exists y_2(x = y_1 + y_2 \wedge \\
&\qquad [wash'(the{-}windows')(y_1)\ \& \\
&\qquad polish'(the{-}floors')(y_2)](e'))](e))] = \\
&\lambda e[\exists x(people'(x) \wedge |x| = 5 \wedge \exists y_1\exists y_2(x = y_1 + y_2 \wedge \\
&\qquad [wash'(the{-}windows')(y_1)\ \& \\
&\qquad polish'(the{-}floors')(y_2)](e)))] = \\
&\lambda e[\exists x(people'(x) \wedge |x| = 5 \wedge \exists y_1\exists y_2(x = y_1 + y_2 \wedge \\
&\qquad \lambda e'[\exists e_1\exists e_2(e' = e_1 + e_2 \wedge wash'(the{-}windows')(y_1)(e_1) \wedge \\
&\qquad polish'(the{-}floors')(y_2)(e_2))](e)))] = \\
&\lambda e[\exists x(people'(x) \wedge |x| = 5 \wedge \\
&\qquad \exists y_1\exists y_2(x = y_1 + y_2 \wedge \exists e_1\exists e_2(e = e_1 + e_2 \wedge \\
&\qquad wash'(the{-}windows')(y_1)(e_1) \wedge \\
&\qquad polish'(the{-}floors')(y_2)(e_2)))))]
\end{aligned}$$

Because generalized sum conjunction decomposes every e-type argument position, both the event and the subject are decomposed in VP conjunction. So this interpretation describes a set of complex events which are sums of washings of the windows and polishings of the floors such that some portion of a group of five people did the washings and some portion did the polishings. The vagueness of the decomposition of tasks at the VP level follows, then, from the properties of generalized sum conjunction; the further vagueness of the internal task decomposition of washings and polishings follows from the assumption of summativity for lexical predicates.

Imagine now what might be necessary to recreate the same effect in Krifka's account. The crucial question to be answered is how to reconstruct the vagueness of decomposition of the subject denotation between the washings and polishings. Because the verbal predicate is simply a set of events, the decomposition cannot be a function of the conjunction of VPs, as it is in the Davidsonian account, since the subject is not a semantic argument of the verbal denotation. Rather, it must be a property of the nominal type-shifting rules themselves, or the denotations of the determiners:

(A.29)

$$\dfrac{\dfrac{\text{five people}}{\text{CN}, \lambda x[people'(x) \wedge |x| = 5]} \qquad \dfrac{}{\begin{array}{c}(\text{NP}_{s1} \wedge \text{NP}_o)/\text{CN},\\ \lambda P \lambda Q \lambda e[\exists y \exists x_{s1} \exists x_o(y = x_{s1} + x_o \wedge \\ P(y) \wedge Q(e))]\end{array}}}{\begin{array}{c}\textbf{FA: } \text{NP}_{s1} \wedge \text{NP}_o,\\ \lambda Q \lambda e[\exists y \exists x_{s1} \exists x_o(y = x_{s1} + x_o \wedge \\ people'(y) \wedge |y| = 5 \wedge Q(e))]\end{array}}$$

Technically, there is nothing wrong with this approach. However, this shifter encodes functionality which is also provided by generalized sum conjunction, functionality which is required of conjunction elsewhere in the grammar. In other words, this shifter is suspiciously redundant. Combined with the problems involving the potential infinity of syntactic indices, this problem indicates that some generalization is being missed. I conclude, then, that Krifka's second account is not compatible with VP coordination either.

A.3 Conclusion

I have not proposed solutions in this section, only problems. As I suggested in Footnote 11 of Chapter 6, I do believe there is a solution to be found; however, as I argue in the body of this study, such a solution would be nothing more than a curiosity, since the compositional neo-Davidsonian account which it supports cannot be justified.

Notes

[1]Note that the semantics of this inference rule is identity. I will return to the semantics in a moment.

[2]The account of Bayer (1996) is presented in terms of applicative Categorial Grammar, in which Antecedent Strengthening, like Type Raising and Function Composition, are arbitrarily stated rules. In the Lambek system of Bayer and Johnson (1995), on the other hand, all these rules are theorems.

[3]The system of Boolean category combination also admits antecedent joint categories and premise meet categories, although not in by virtue of a rule of inference. Both Antecedent Strengthening and Premise Weakening reflect the fact that any conclusion which can be reached with a given set of assumptions can also be reached with a stronger set of assumptions. Therefore, if we begin with stronger assumptions, weaken them, and still derive the desired conclusion, we know that the derived conclusion is valid for the stronger set of assumptions as well. Premise Weakening weakens assumptions; so does Antecedent Strengthening, by imposing more restrictive conditions on the form of the antecedent. On the other hand, introducing a meet into a premise, or introducing a join into an antecedent, does not preserve validity of inference, because conclusions derived from stronger assumptions do not necessarily hold for corresponding weaker assumptions. As a result, no globally valid rule of inference introduce meets into premises or joins into antecedents. What these Boolean operations correspond to are lexical facts. For instance, antecedent join categories indicate subcategorization alternatives; if a verb has the category $A/(B \vee C)$, the presence of either a B or a C will allow us to derive an A. If we're given a B, then, the rule of Premise Weakening will allow us to derive a $B \vee C$, in order to feed Function Application. Premise meet categories indicate other lexical ambiguities, such as those corresponding to neutralization of features; see Bayer and Johnson (1995) for details.

[4]One might well ask what the difference is between the sense of *drink* used here and the one used in the transitive case. This issue is exactly the one raised by Carlson and Parsons which I discussed in Chapter 7, *q.v.*

[5]We will see here again that the assumptions we make about lexical meanings and free variables interact with Carlson's and Parsons' arguments from Chapter 7. I will not pursue the matter further here.

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